

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE December 1994	3. REPORT TYPE AND DATES COVERED Technical Memorandum		
4. TITLE AND SUBTITLE The Technical Communication Practices of Aerospace Engineering and Science Students: Results of the Phase 4 Cross-National Surveys*		5. FUNDING NUMBERS WU 505-90		
6. AUTHOR(S) Thomas E. Pinelli, Laura M. Hecht, Rebecca O. Barclay, and John M. Kennedy				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NASA Langley Research Center Hampton, VA 23681-0001		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, DC 20546-0001		10. SPONSORING/MONITORING AGENCY REPORT NUMBER NASA TM-109123		
11. SUPPLEMENTARY NOTES *Report number 28 under the NASA/DoD Aerospace Knowledge Diffusion Research Project. Thomas E. Pinelli: Langley Research Center, Hampton, VA; Laura M. Hecht: Indiana University, Bloomington, IN; Rebecca O. Barclay: Rensselaer Polytechnic Institute, Troy, NY; John M. Kennedy: Indiana University, Bloomington, IN.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified—Unlimited Subject Category 82 Availability: NASA CASI (301) 621-0390		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) This report describes similarities and differences between undergraduate and graduate aerospace engineering and science students in the context of two general aspects of the educational experience. First, we explore the extent to which students differ regarding the factors that lead to the choice of becoming an aerospace engineer or a scientist, current satisfaction with that choice, and career-related goals and objectives. Second, we look at the technical communication skills, practices, habits, and training of aerospace engineering and science students. The reported data were obtained from a survey of students enrolled in aerospace engineering and science programs at universities in India, Japan, Russia, and the United Kingdom. The surveys were undertaken as part of the NASA/DoD Aerospace Knowledge Diffusion Research Project. Data are reported for the following categories: student demographics; skill importance, skill training, and skill helpfulness; collaborative writing; computer and information technology use and importance, use of electronic networks; use and importance of libraries and library services; use and importance of information sources and products; use of foreign language technical reports; and foreign language (reading and speaking) skills.				
14. SUBJECT TERMS Knowledge diffusion; Aerospace engineering and science students; Computer and information technology use; and Library use and importance			15. NUMBER OF PAGES 86	
			16. PRICE CODE A05	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT	

NASA/DoD Aerospace Knowledge Diffusion Research Project

NASA Technical Memorandum 109123

Report Number 28

*The Technical Communication Practices of Aerospace Engineering and
Science Students: Results of the Phase 4 Cross-National Surveys*

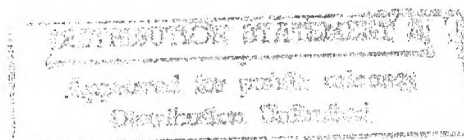
Thomas E. Pinelli
NASA Langley Research Center
Hampton, Virginia

Laura M. Hecht
Indiana University
Bloomington, Indiana

Rebecca O. Barclay
Rensselaer Polytechnic Institute
Troy, New York

John M. Kennedy
Indiana University
Bloomington, Indiana

December 1994



19950303 061



National Aeronautics and Space Administration

Department of Defense

INDIANA UNIVERSITY

INTRODUCTION

The growing national debate over U.S. competitiveness appears to have produced a consensus of opinion on the following points: (1) the production, transfer, and use of knowledge is of paramount importance to the process of technological innovation; (2) current "supply-side" U.S. technology policy, which emphasizes the creation of knowledge, should be modified to include the transfer, absorption, and utilize of that same knowledge; (3) a mechanism that contains a "proactive" scientific and technical information (STI) component is needed for the diffusion of knowledge from government research facilities to industry; (4) engineers and scientists should be proficient in the acquisition, communication, and use of STI; and (5) engineering and science students should be trained in the acquisition, communication, and use of STI as part of their educational preparation.

Studies such as those conducted by Mailloux (1989) demonstrate that communicating information takes up as much as 80% of an engineer's time and is considered essential to successful engineering practice. Surveys of industrial firms that employ engineers and scientists indicate that employers place a high priority on engineers' ability to acquire, to communicate orally and in writing, and to use STI. These same studies show that industry respondents rate the importance of communications skills as high as or higher than their technical skills. Many industry respondents hold the opinion that newly graduated engineers and scientists lack proficiency in communications skills (Black, 1994; Morrow, 1994; Evans, et al., 1993; Katz, 1993; Strother, 1992; Garry, 1986; Devon, 1985; and Sylvester, 1980).

Because the effective communication of information is fundamental to engineering, questions arise of what communications skills should be taught to engineering students and when, how much communications instruction is necessary, and how effective that instruction is. What is missing from any discussion of communications skills instruction for engineering student is (1) a clear explanation from the professional engineering community about what constitutes "acceptable and desirable communications norms" within that community; (2) adequate and generalizable data from engineering students about the communications skills instruction they receive; (3) adequate and generalizable data from entry-level engineers about the adequacy and usefulness of the instruction they received as students; and (4) a mechanism, probably focused within academia, that solicits feedback from the workplace and a system that utilizes the feedback for answering the questions of what and how much should be taught and when, and for determining the effectiveness of instruction.

To address the second question and help provide a student perspective, we undertook a survey of aerospace engineering and science students in four countries: India, Japan, Russia, and the United Kingdom (U.K.)¹ in the spring of 1994. The questions were assembled according to the following topics: (1) the students' selection of a career in engineering; (2) the importance

¹Similar surveys were conducted among engineering and science students attending the University of Illinois, aerospace engineering students at Texas A&M, and technology students at Bowling Green State University. Student members of the American Institute of Aeronautics and Astronautics (AIAA) were also surveyed in the spring of 1993.

of selected communications skills to professional success, the instruction received in these skills, and the helpfulness (usefulness) of that instruction; (3) the use and importance of libraries and other information sources and products; and (4) the use of computers, selected information technologies, and electronic networks. This study contributes to our understanding of the production, transfer, and use of information by aerospace engineering and provides feedback that may be helpful in shaping the communications components of engineering curricula in higher education.

BACKGROUND

The diffusion of knowledge, including its production, transfer, and use, is an essential part of aerospace R&D and is of paramount importance to the process of innovation within the U.S. aerospace industry. To learn more about this process, researchers at the NASA Langley Research Center, the Indiana University Center for Survey Research, Rensselaer Polytechnic Institute, and institutions in selected counties organized a research project to study knowledge diffusion in aerospace. Sponsored by NASA and the DoD, endorsed by aerospace professional societies, and sanctioned by several groups and panels, the *NASA/DoD Aerospace Knowledge Diffusion Research Project* was begun in 1989 as a five-year project "to provide descriptive and analytical data regarding the flow of scientific and technical information (STI) at the individual, organizational, national, and international levels and to examine both the channels used to communicate STI and the social system of the aerospace knowledge diffusion process" (Pinelli, Kennedy, and Barclay, 1991). The Project, in four phases, focuses on technology rather than science and on engineers rather than scientists and takes the position that STI resulting from federally funded aerospace R&D is an economic asset or resource rather than a component of national security. The Project Fact Sheet is Appendix A.

The research results of the Project could be used to understand the information environment in which U.S. aerospace engineers and scientists work (that is, the academic, government, and industrial sectors), the information-seeking behaviors of U.S. aerospace engineers and scientists, and the factors that influence their use of STI. Such an understanding could (1) lead to the development of practical theory, (2) contribute to the design and development of systems for diffusing aerospace information, and (3) have practical implications for transferring the results of federally funded R&D to the U.S. aerospace community.

METHODS AND SAMPLE DEMOGRAPHICS

A group of engineering faculty members, librarians, and technical communicators worked with the Project team to compile the list of survey questions. The questions were pretested before distribution. The student survey is Appendix B. Faculty members in each of the four countries distributed self-administered (self-reported) questionnaires to aerospace engineering and

science students at their respective universities in the spring of 1994.² English-language questionnaires were used in India and the U.K. The survey was translated into Japanese and Russian for use in Japan and Russia, respectively. With minor exceptions, the questionnaires used in the four countries were identical. Code books containing the aggregate responses from three of the four countries are Appendix C. A word of caution: The samples from each country are small. The samples are, in all likelihood, not representative of all aerospace engineering and science students in each of the respective countries. Given this limitation, the data should be regarded as exploratory rather than conclusive. The results should be interpreted cautiously. Finally, no statistical test(s) or treatment has been applied to the data.

PRESENTATION OF THE DATA

Demographic information for the student samples appears in table 1. The number of respondents for each country included -- India (40), Japan (77), Russia (117), and the United Kingdom (U.K.) (127). The majority of the student respondents were male. About 15% of the U.K. and 13% of the Russian students were female.³ About 4% of the Japanese students were women. There were no female students in the Indian sample.

The sample included both undergraduate and graduate students. The entire Indian sample was composed of graduate students. Slightly more than half (54.1%) of the Japanese students were undergraduates and 61% of the Russian students were graduate students. Slightly more than three-quarters (78.2%) of the students from the U.K. were graduate students. Most of the students surveyed were being educated to become engineers. About three-quarters of the Indian students (72.5%) and U.K. students (73.2%) were preparing to become engineers. About 90% of the Russian and almost all (97.3%) of the Japanese students were preparing to become engineers. Twenty percent of the Indian students and about 16% of the U.K. students were preparing to become scientists.

With the exception of the U.K. students, most of the students were citizens of the country in which their school was located. Forty-five percent of the U.K. students reported that they were not a citizen of the country where they attended school. Further, 46% of the U.K. students stated that the U.K. was not their native country. The majority of the students from Japan and Russia were not members of a professional student (national) engineering, scientific, or technical society.

²The student surveys were conducted at the Indian Institute of Science, the University of Tokyo, Moscow Aviation Institute, Cranfield University, and the University of Southampton.

³These percentages are approximately equal to the percentages of female students who responded to the AIAA national student survey we conducted in the U.S.

Distribution	
Availability Codes	
Dist	Avail and/or Special
A-1	

Finally, we asked respondents to compare their families's incomes with the incomes of most families in their native countries. Most students reported family incomes that were equal to or greater than the incomes of most other families. About 23% of the Russian students, about 11% of the U.K., and 13% of the Japanese students reported that their families's incomes were lower than the incomes of other families in their countries.

Table 1. Survey Demographics

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Demographics	%	%	%	%
Gender				
Female	---	4.1	13.0	14.6
Male	100	95.9	87.0	85.4
Educational Status				
Undergraduate	---	54.1	39.0	14.7
Graduate	100	37.8	61.0	78.2
Other	---	8.1	---	6.6
Educational Preparation As				
An Engineer	72.5	97.3	89.2	73.2
A Scientist	20.0	2.7	6.9	15.5
Other	7.5	0.0	3.9	11.4
Native Country				
India	100	---	---	1.6
Japan	---	100	---	1.6
Russia	---	---	100	0.8
U.K.	---	---	---	49.6
Other	---	---	---	46.3
Member Of A Professional Student (National) Engineering, Scientific, Or Technical Society				
Yes	---	28.8	15.5	66.7
No	---	71.2	84.5	33.3
Citizen of Country Where You Attend School				
Yes	100	93.2	94.4	54.9
No	---	6.8	5.6	45.1
Income Relative To Other Families In Native Country				
Higher than Other Families	27.5	22.7	15.3	42.4
About the Same as Other Families	65.0	62.7	68.6	44.8
Lower than Other Families	5.0	12.9	23.3	11.2
Can't Compare to Other Families	2.5	2.7	2.9	1.6

Aerospace Engineering as a Career Choice

With the exception of the Indian students, most students made their decision to study engineering prior to starting college (see table 2). There is some variation among students' reports of the timing of their career decision choice. The Japanese sample contains the highest percentage of students who indicated that they had made their career choices while still in elementary school (26%). About half of Russian, Japanese, and British respondents reported that they had made their decisions while still in high school. About 35% of Russian and British students and 25% of Japanese students decided to study engineering and science when they started or after they started college. In addition, 65% of Indian respondents reported that they had made their career choices when they started or after they started college⁴.

Table 2. Career Choice/Selection Decision Point
of Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Decision Points	%	%	%	%
While Still In Elementary School	2.5	26.0	11.2	8.7
While In High School	17.5	49.3	47.4	50.8
When Starting College	30.0	6.5	17.2	16.8
After Starting College	35.0	18.2	19.0	18.0
Other	15.0	---	5.2	5.7

Factors Influencing Career Choice

Students were asked to rate the importance of six factors that may have influenced their choice of careers (table 3). Three of the factors deal with the influence of people (i.e., parents, other family members, and teachers) in helping students to make their career choices; one factor focused on the influence of information about the career. The remaining two factors related to the career itself and include such elements as financial security.

⁴All of the respondents in the Indian sample are graduate students. The higher percentage of Indian students compared to the other samples who report that they made their career choice after entering college may in fact represent their decisions to study at the graduate level rather than their initial decisions to study engineering and science at the undergraduate level.

The expectation that engineering work is intrinsically rewarding was the factor having the single greatest influence on the career choice for Indian (60%), Japanese (76.6%), and U.K. students (71.5%). Access to information on career opportunities was the most important or influential factor (45%) for Russian students. Fifty percent of the Indian students reported that access to information on career opportunities was an important or influential factor in making their choice to pursue a career in aerospace engineering or science.

Importance ratings of the influence of other people -- parents, teachers, and other family members -- were lower than the importance rating of job-related factors. Of the three factors concerned with the influence of people (i.e., parents, other family members, and teachers) in helping students to make their career choices, the encouragement of parents appears to have exerted greater influence on career choice than did encouragement from other family members and teacher. Students in the Indian sample, however, reported that the encouragement of teachers had a greater influence on their career decisions than did parents and other family members.

Table 3. Influence (Importance) of Selected Factors on Career Choice of Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Factors	% ^a	% ^a	% ^a	% ^a
Your Parents Encouraged Your Area Of Study/Major	37.5	3.9	21.5	14.6
Other Family Members Encouraged Your Area Of Study/Major	12.5	2.6	8.8	9.8
Teachers Encouraged Your Area Of Study/Major	40.0	1.3	13.1	15.7
You Feel That A Career In Your Major/Area Of Study Will Lead To Financial Security	30.0	7.8	16.9	23.0
You Feel That A Career In Your Major/Area Of Study Will Provide A Career With Rewarding Activities	60.0	76.6	12.7	71.5
Information On The Career Opportunities Available In Your Major/Area Of Study	50.0	24.7	45.0	18.9
Other Factors	25.0	7.8	30.8	22.0

^aStudents used a 7-point scale to rate the importance of each factor, where 7 indicates the highest rating. Percentages include combined "6" and "7" responses.

Satisfaction with Career Choice

Students were asked to rate their current level of satisfaction with their career choice (table 4). Forty five percent of Indian students and 32% of the U.K. students reported that they are happier with their career decisions now compared to when the decisions were first made. About 43% of the Indian and about 63% of the Japanese students reported that they feel about the same now as when they first made their career decisions. About 38% of the Russian students reported they were less happy with their career choice now than when they first made them.

Table 4. Career Choice/Selection Satisfaction
of Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Satisfaction Level	%	%	%	%
I Am Happier About My Career Choice Now Than When I First Made It	45.0	13.0	25.2	32.0
I Feel About The Same Now As When I First Made It	42.5	62.3	36.5	45.1
I Am Less Happy About My Career Choice Now Than When I First Made It	12.5	24.7	38.3	23.0

Career Expectations and Goals

This section explores the expectations of student respondents concerning several aspects of their future careers. Students were asked to indicate the type of organization in which they hope to work after graduation. They were also given a list of 15 specific career goals and aspirations and asked to rate the importance of each to a successful career.

Type of Organization. Students were asked to identify the type of organization in which they hope to work after graduation. Table 5 shows their organizational preferences. With the exception of the Indian students, most students report that they plan to work in either national or multi-national industry. Indian respondents plan to work in either academia (52.5%) or in government (27.5%). About 35% of the Japanese respondents indicated that they planned to work in academia, compared to about 13% of British students and less than 9% of the Russian students. Japanese students were the least interested in working in government (2.6%). Just under 24% of the Russian students and about 20% of the British students indicated that they

planned to work in government. Small percentages of the students reported that they planned to work for a non-profit organization. Slightly more than 5% of the Japanese students reported that they planned to work for a non-profit organization.

Professional Aspirations. Students were asked to rate the importance of 15 goals to a successful career. The list includes aspirations that are classified as either engineering, science, or management goals. Table 6 shows the importance ratings for each goal. Student respondents in each of the four groups gave the highest ratings to the engineering-related goals and aspirations. The ordering of the importance ratings for these factors, from highest to lowest, is similar for all student members with one exception. The opportunity to explore new ideas about

Table 5. Type of Organization Where Aerospace Engineering and Science Students Plan to Work

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Type Of Organization	% ^a	% ^a	% ^a	% ^a
Academic	52.5	35.1	8.5	13.4
Government	27.5	2.6	23.9	19.7
Industry (National)	5.0	29.9	17.9	27.6
Industry (Multi-national)	10.0	19.5	23.9	51.2
Not for Profit	---	5.2	2.6	3.1
Other	5.0	5.2	16.2	4.7

^aPercentages do not total 100 because students could select more than one response.

Overall, students from all four countries rated career goals and aspirations relating to the engineering (technology) aspects of an engineering career as more important than career goals and aspirations relating to developing a science (professional reputation) or advancing into leadership (management) positions. In all four samples, more students rated having the opportunity to explore new ideas about technology or systems as the most important career goal or aspiration. Eighty two percent of Indian, about 80% of Japanese students, about 66% of the Russian, and about 65% of the British students rated this goal and aspiration most important to career success.

The patterns of students' importance ratings in the remainder of the engineering category and in the science and leadership categories, however, show that there is significant variation among samples in students' ratings of specific goals and aspirations. For example, in the technology category, having the opportunity to work on complex technical problems was the second most important goal for Indian students (73%). In contrast, this was the fourth most important factor for Russian students (50%) and for Japanese students (64.5%), and the least important factor for British students (44.1%).

Table 6. Career Goals and Aspirations of Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Goals	% ^a	% ^a	% ^a	% ^a
Engineering				
Have The Opportunity To Explore New Ideas About Technology Or Systems	82.0	80.2	66.1	65.3
Advance to High Level Staff Technical Position	55.0	46.0	35.4	52.0
Have The Opportunity To Work On Complex Technical Problems	73.0	64.5	50.0	44.1
Work On Projects That Utilize The Latest Theoretical Results In Your Specialty	60.0	68.4	58.5	46.0
Work On Projects That Require Learning New Technical Knowledge	67.5	68.9	55.3	57.6
Science				
Establish A Reputation Outside Your Organization As An Authority In Your Field	65.0	24.6	59.1	49.6
Receive Patents for Your Ideas	35.8	23.0	57.8	18.6
Publish Articles In Technical Journals	75.0	25.7	31.2	25.4
Communicate Your Ideas To Others In Your Profession by Presenting Papers At Professional Meetings	57.5	47.4	45.6	37.3
Be Evaluated On The Basis Of Your Technical Contributions	67.5	40.3	38.1	42.7
Leadership (Management)				
Become A Manager Or Director	22.5	23.7	33.9	60.3
Plan And Coordinate The Work Of Others	35.0	11.0	25.9	58.8
Advance To A Policy- making Position In Management	30.8	19.0	31.2	67.4
Plan Projects And Make Decisions Affecting The Organization	36.9	33.4	40.5	73.4
Be The Technical Leader Of A Group Of Less Experienced Professionals	21.1	21.1	25.5	50.4

^aStudents used a 7-point scale to rate the importance of each goal, where 7 indicates the highest rating. Percentages include combined "6" and "7" responses.

Among goals and aspirations related to science (the development of a professional reputation), Indian students rated the goal of publishing articles in technical journals more importantly than any other goal in this category (75%). About 31% of the Russian students, 25.7% of the Japanese students, and 25.4% of British students considered the goal of publishing articles in technical journals to be important. Russian students were most interested in establishing a reputation outside of their organization as an authority in their field (59.1%) and in receiving patents for their ideas (57.8%). The goal rated most important by the Japanese students was communicating ideas to others by delivering papers at professional meetings (47.4%) and being evaluated on the basis of their technical contributions (40.3%). British students rated the goals of (1) establishing a professional reputation outside of the organization (49.6%) and (2) to being evaluated on the basis of their technical contributions (42.7%) most important.

Students from the U.K. consistently rated career goals and aspirations associated with leadership (management) higher than did the Indian, Japanese, and Russian students. Of the five career goals and aspirations in this category, U.K. students rated "planning projects and making decision affecting the organization" most important (73.4%) followed by "advancing to a policy-making position in management" (67.4%). Of the five career goals and aspirations in this category, Russian (40.5%), Indian students (36.9%), and Japanese students (33.4%) rated "planning projects and making decision affecting the organization" most important.

Communications Skills

The literature on engineering education establishes the importance of effective communications skills to professional success (Black, 1994; Morrow, 1994; Evans, et. al., 1993; Katz, 1993; Garry, 1986; Devon, 1985). Student survey respondents were asked to assess the importance of selected communications skills to professional success, to indicate if they had received instruction in these skills, and to rate the helpfulness (usefulness) of that instruction.

Importance of Communications Skills Training

Students were asked to rate the importance of six communications skills to professional career success (table 7). Although there are variations in students' importance ratings of each of the six skills across the four samples, as well as their relative rankings of these skills within each sample, students in all four samples rate the importance of the six skills high. Indian students consistently assigned higher importance ratings to these (competencies) skills than did Japanese, Russian, and U.K. students. For example, 90% of the Indian students reported that the ability to effectively communicate technical information in writing is an important skill, compared to about 67% of the Japanese, about 68% of the U.K., and about 48% of the Russian students. The skill (competency) that received the highest importance ratings across samples is the ability to use computer, communication, and information technology. This skill was rated most important by the Russian (85.6%) and U.K. (85.8%) students, and was rated second in importance by Indian (87.5%) and Japanese students (71%).

**Table 7. Importance of Selected Communications Skills to
Aerospace Engineering and Science Students**

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Competencies	% ^a	% ^a	% ^a	% ^a
Effectively Communicate Technical Information In Writing	90.0	67.2	48.2	67.8
Effectively Communicate Technical Information Orally	77.5	67.1	53.6	71.7
Have A Knowledge And Understanding Of Engineering/Science Information Resources And Materials	87.5	77.9	71.0	62.6
Ability To Search Electronic (Bibliographic) Data Bases	42.4	47.2	73.4	41.9
Ability To Use A Library That Contains Engineering/Science Information Resources And Materials	82.0	48.0	64.8	49.6
Effectively Use Computer, Communication And Information Technology	87.5	71.0	85.6	85.8

^aStudents used a 7-point scale to rate the importance of each competency, where 7 indicates the highest rating. Percentages include combined "6" and "7" responses.

Receipt and Helpfulness of Communications Skills Instruction

Table 8 shows the percentage of students who have received communications skills instruction. Overall, U.K. students received more communications skills instruction than did the Indian, Japanese, and Russian students. More than 50% of all the U.K. students received training in all six of the communication skills. About 81% of the U.K. students received instruction in using a library that contains engineering/science information and resources followed by instruction in using computer, communication, and information technology (75.8%) and searching electronic (bibliographic) data bases.

By contrast, Japanese students received the least amount of communications skills instruction. About 43% of Japanese respondents reported that they had received training in using computer, communication and information technology. Less than 14% of the Japanese students had received instruction in each of the five remaining communication skills. About 64% of the Indian students had received instruction in using computer, communication and information technology. By contrast, about 18% and 23% of the Indiana students had received instruction in searching electronic (bibliographic) data bases and speech/oral communication. Among the Russian students, about 60% had received instruction in using engineering/science information

resources and materials and about 54% had received instruction in using a library that contains engineering/science information resources and materials. Just over 40% of the Russian students reported that they received training in technical writing/communication and speech/oral communication.

Table 8. Communications Skills Instruction Received by Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Instruction	%	%	%	%
Technical Writing/Communication	36.8	10.5	41.1	54.0
Speech/Oral Communication	23.1	13.2	43.8	60.5
Using A Library That Contains Engineering/Science Information Resources And Materials	33.3	10.5	53.6	81.3
Using Engineering/Science Information Resources And Materials	43.6	9.3	59.5	61.3
Searching Electronic (Bibliographic) Data Bases	17.9	11.7	17.1	75.0
Using Computer, Communication, And Information Technology	64.1	43.4	32.4	75.8

Students receiving communications skills instruction were asked to rate the helpfulness (usefulness) of that instruction (table 9). Although a larger percentage of the U.K. students received communications skills instruction than did the Indian, Japanese, and Russian students, the U.K. students reported that their training was not particularly helpful. About 60% reported that their instruction in using computer, communication and information technology was helpful. Fewer than 45% of the U.K. students surveyed reported that their training in the other five communication skills was helpful. Overall, Indian and Russian students rated the communication skills instruction they received "more helpful" than did the Russian and U.K. students.

Indian students rated the skills instruction they received in speech/oral communication highest (77.8%) followed by instruction in searching electronic (bibliographic) data bases (71.4%) and using engineering/science information resources and materials (70.6%). Russian students rated the instruction they received in using computer, communication, and information technology highest (65%) followed by instruction in using engineering/science resources and materials (63.6%) and in using a library that contains engineering/science resources and materials (61.5%).

Table 9. Helpfulness of Communications Skills Instruction
Received by Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Instruction	% ^a	% ^a	% ^a	% ^a
Technical Writing/Communication	64.3	50.0	38.3	40.8
Speech/Oral Communication	77.8	36.4	42.6	47.5
Using A Library That Contains Engineering/Science Information Resources And Materials	42.3	37.5	61.5	40.6
Using Engineering/Science Information Resources And Materials	70.6	33.3	63.6	36.1
Searching Electronic (Bibliographic) Data Bases	71.4	10.0	50.0	43.4
Using Computer, Communication, And Information Technology	60.0	40.0	65.0	60.8

^aStudents used a 7-point scale to rate the helpfulness of the instruction, where 7 indicates the highest rating. Percentages include combined "6" and "7" responses. Percentages exclude responses who did not receive instruction.

Impediments to Preparing Written Technical Communications

We asked students to report the extent to which a lack of knowledge/skill about certain communications principles impedes their ability to prepare written technical communications (table 10). Overall, students did not report serious problems with their writing skills, at least to the point that any deficiencies might impede the technical writing process. The lowest "impedance" scores (i.e., scores clustering around 50% or higher) were recorded only four times.

In terms of their ability to prepare written technical communication, about 37% of the Indian students reported difficulty with preparing/presenting information in an organized manner; about 36% reported difficulty in defining the purpose of the communication. Japanese students reported the greatest difficulty with preparing/presenting information in an organized manner (58.3%) and in defining the purpose of the communication (50%). About 58% and 54% of the Russian students reported difficulty with defining the purpose of the communication and preparing/presenting information in an organized manner.

Collaborative Writing

Most students in the sample have some experience in collaborative writing (table 11). Indian students reported that about 52% of their written technical communication involved

**Table 10. Factors Impeding the Ability of Aerospace
Engineering and Science Students to Produce Written Technical Communication**

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Principles	% ^a	% ^a	% ^a	% ^a
Defining The Purpose Of The Communication	36.4	50.0	57.9	21.4
Assessing The Needs Of The Reader	31.0	22.1	33.8	19.4
Preparing/Presenting Information In An Organized Manner	37.1	58.3	54.3	25.0
Developing Paragraphs (Introductions, Transitions, Conclusions)	28.6	32.4	35.1	21.6
Writing Grammatically Correct Sentences	20.0	22.7	32.9	15.9
Notetaking And Quoting	12.5	23.1	23.7	13.7
Editing And Revising	29.0	26.3	43.4	13.2
Other	---	1.3	6.8	0.8

^aStudents used a 7-point scale to measure the extent to which each principle impedes their ability to produce written technical communications, where 7 indicates greatly impedes. Percentages include combined "6" and "7" responses.

collaborative writing. On average, about 33% and 18%, respectively, of the written technical communication performed by the Russian and U.K. students involved collaborative writing. On average, about 19% of the written technical communication performed by Japanese students involved collaborative writing.

Table 11 also reports the percentage of students' written technical communication that is required to be collaborative. A greater percentage of students' written technical communication is required to be collaborative. On average, about 54%, 43%, 40%, and 38% of the written technical communication performed by Indian, Russian, Japanese, and U.K. students are required to be collaborative.

We also asked students who write collaboratively to compare the productivity of group writing to the productivity of writing alone (table 12). A high percentage of Indian (43.3%) Japanese (41.4%), and Russian (71%) students, respectively reported that writing alone was less productive than writing alone. About 38% of the U.K. students indicated that collaborative writing was more productive than writing alone.

**Table 11. Production of Written Technical
Communication By Aerospace Engineering and Science Students**

Factor	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=1270)
	%	%	%	%
Percentage Of Written Technical Communication Involving Collaborative Writing				
0%	14.7	63.2	33.0	41.6
1 - 24%	5.9	14.7	17.0	34.5
25 - 49%	11.8	4.4	9.1	7.1
50 - 74%	35.3	4.4	25.0	9.7
75 - 99%	17.6	2.9	11.4	6.2
100%	14.7	10.3	4.5	0.9
Mean %	52.1	18.5	33.0	17.8
Median %	50.0	0.0	25.0	5.0
Percentage Of Written Technical Communication Required To Be Collaborative?^a				
0%	16.0	---	3.6	6.6
1 - 24%	20.0	18.2	21.4	32.8
25 - 49%	40.0	40.9	21.4	14.8
50 - 74%	16.0	31.8	39.4	32.8
75 - 99%	80.0	9.1	7.1	8.2
100%	---	---	7.1	4.9
Mean %	53.5	40.2	43.3	38.3
Median %	50.0	40.0	50.0	30.0

^aPercentages exclude students who report that they never collaborate on academic writing projects.

Use and Importance of Libraries and Selected Information Sources and Products

This section examines the use and importance of libraries and STI sources and products to engineering and science students. First, we examine the type of library use instruction that student respondents received, the effectiveness of the information obtained from the library in meeting students' engineering/science information needs, and their use (search) of electronic (bibliographic) data bases. Finally, we explore the use and importance of selected information sources and products.

Table 12. Productivity of Collaborative Writing
of Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
How Productive	% ^a	% ^a	% ^a	% ^a
Less Productive Than Writing Alone	43.4	41.4	71.0	30.3
About As Productive As Writing Alone	37.6	34.5	22.5	31.8
More Productive Than Writing Alone	20.0	24.1	6.5	37.9

^aPercentages exclude students who report that they never collaborate on academic writing projects.

Library Use Instruction

We asked students to indicate whether they had received instruction in six areas related to library use. These data are summarized in table 13. Higher percentages of U.K. students reported receiving library training than did Indian, Russian, and Japanese respondents. Nearly 80% of the U.K. students had participated in a library tour, and about 71% reported that they had received library instruction for end-users in searching electronic (bibliographic) data bases. About (62%) received a library presentation as part of their academic orientation. Nearly 57% of the U.K. students reported receiving library orientation as part of an engineering or science course.

About 33% of the Indian students received a library tour or presentation as part of their academic orientation. About 35% of the Indian students had received a library skill/use course in engineering/science information resources and materials. About 9% received library orientation as part of an engineering or science course. About 23% of the Russian students received a presentation as part of their academic orientation. About 13% of the Russian students reported receiving library orientation as part of an engineering or science course.

As a group the Japanese students received less library training than did the members of other three student groups. About 18% and 15%, respectively, of the Japanese students received a library presentation as part of academic orientation and library orientation as part of an engineering or science course. About 8% of the Japanese students had participated in a library tour. About 23% of the Russian students reported participating in a library presentation as part of their academic orientation. About 13% of the Russian students received library orientation as part of an engineering or science course and about 13% had received a library tour.

About 79% of the U.K. students had received a library tour and about 62% had received a library presentation as part of their academic orientation. A majority (57%) of the U.K. students had received a library skill course in bibliographic instruction, training in using engineering/science information resources and materials (58.3%), and in searching electronic (bibliographic) data bases (71.4%).

Table 13. Library Training Received
by Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Type Of Instruction	%	%	%	%
Library Tour	33.3	8.3	13.0	78.9
Library Presentation As Part Of Academic Orientation	33.3	17.8	23.1	62.1
Library Orientation As Part Of An Engineering/Science Course	9.1	15.3	12.8	56.6
Library Skill/Use Course (Bibliographic Instruction)	22.2	2.7	14.5	57.0
Library Skill/Use Course In Engineering/Science Information Resources And Materials	35.3	2.7	15.6	58.3
Library Instruction For End-user Searching Of Electronic (Bibliographic) Data Bases	20.0	8.2	10.0	71.4

Library Use

We also asked students respondents to indicate the number of times that they had used a library during the current school term (see table 14). On average, Indian and U.K. students

Table 14. Use of A Library This School Term by
Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Visits	%	%	%	%
0 Times	---	5.4	24.5	---
1 - 5 Times	---	43.2	50.3	24.5
6 - 10 Times	8.3	35.1	11.3	20.6
11 - 25 Times	29.2	8.1	9.4	23.5
26 - 50 Times	29.2	8.1	2.8	27.5
51 Or More Times	33.3	---	1.9	3.9
Mean	28.1	9.6	5.0	20.8
Median	20.0	6.0	3.0	15.0

made greater use (i.e., visited the library more times) of a library than did the Japanese and Russian students. Slightly more than 5% and about 25% of the Japanese and Russian students used a library "0" times during the school term. The fact that Indian students and about 75% of the British students are graduate students and the majority of Russian and Japanese students are undergraduates may explain the difference in library use. Typically, graduate students have information needs that generally cannot be satisfied by textbooks and other classroom materials. Therefore, graduate students would be expected to make more frequent use of library resources than would undergraduate students.

Effectiveness of Information Obtained From the Library

Those students who had used a library during the current term were asked to rate the effectiveness of the information obtained from the library in meeting their engineering/science information needs (see table 15). The overall rating of the "effectiveness of the information received" was about equal for the four student groups. About 63% of the Indian students reported that the information received from the library was very effective; none of the Indian students reported that the information they received was very ineffective in terms of meeting their information needs. Between 40% and 49% of the U.K., Japanese, and Russian students reported that the information they obtained from the library was very effective in meeting their information needs. Between 3% and 10% of U.K., Japanese, and Russian students reported that the information they obtained from the library was very ineffective in meeting their information needs.

Table 15. Effectiveness of Information Obtained From the Library
in Meeting Information Needs of Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Effectiveness	% ^a	% ^a	% ^a	% ^a
Very Effective	57.5	43.4	48.7	40.0
Neither Effective Nor Ineffective	42.5	50.7	41.0	57.6
Very Ineffective	---	5.8	10.3	2.4
Mean	5.6	5.2	5.2	5.2

^aStudents used a 7-point scale to rate the effectiveness of the information they obtained from the library, where 7 indicates the highest rating. Percentages include combined "6" and "7" responses.

Reasons for Nonuse of a Library

We also asked the students who had not used a library during the current term to indicate their reasons for non-use. The percentages of non-users by the reason for non-use of a library appear in table 16. All of the Indian and U.K. students reported using a library at least one times

during the current school term. About 75% of Japanese non-users and about 53% of Russian non-user reported that they had no information needs. About 75% of the Russian non-users reported that their information needs were met some other way. Russian students also listed considerably more reasons for library non-use than did respondents in the other three student groups.

Table 16. Reasons Aerospace Engineering and Science Students Did Not Use A Library During This Current School Term

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Reasons	% ^a	%	%	% ^a
I Had No Information Needs	--	100.0	65.7	--
My Information Needs Were More Easily Met Some Other Way	--	0.0	78.2	--
Tried The Library Once Or Twice Before But I Couldn't Find The Information I Needed	--	0.0	54.5	--
The Library Is Physically Too Far Away	--	0.0	15.8	--
The Library Staff Is Not Cooperative Or Helpful	--	0.0	54.5	--
The Library Staff Does Not Understand My Information Needs	--	0.0	60.0	--
The Library Did Not Have The Information I Need	--	0.0	72.7	--
I Have My Own Personal Library And Do Not Need Another Library	--	25.0	63.6	--
The Library Is Too Slow In Getting The Information I Need	--	0.0	31.6	--
We Have To Pay To Use The Library	--	0.0	0.0	--
We Are Discouraged From Using The Library	--	0.0	60.0	--

^aAll Indian and U.K. student respondents reported that they used a library at least once this school term and, therefore, did not report "0" times use to Q.18.

Searching of Electronic (Bibliographic) Data Bases

We were also interested in finding out how students search electronic (bibliographic) data bases (table 17). About 73% of the Russian students reported that they do not have access to electronic (bibliographic) data bases and about 15% of Russian students indicate that they have not used these types of data bases. Of the four student groups, the U.K. students appear to have the greatest access to electronic (bibliographic) data bases. Of those students that do use them, about 81% of the U.K. students report that they conduct most or all of their own data base

searches. About 15% of the U.K. students report that they do most or all searches through a librarian. About 31% of the Indian and about 32% of the Japanese students indicated that they do most or all of their data base searches themselves. About 31% of the Indian students and about 20% of the Japanese students report that they do most or all searches through a librarian.

Table 17. How Aerospace Engineering and Science Students Search Electronic (Bibliographic) Data Bases

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Approach	%	%	%	%
I Do All Searches Myself	10.3	11.7	4.9	41.7
I Do Most Searches Myself	20.5	20.8	4.9	38.9
I Do Half By Myself And Half Through A Librarian	10.3	11.7	1.0	11.9
I Do Most Searches Through A Librarian	5.1	3.9	1.8	3.2
I Do All Searches Through A Librarian	15.4	3.9	---	---
I Do Not Use Electronic Data Bases	28.2	31.2	14.6	4.0
I Do Not Have Access To Electronic Data Bases	10.3	16.9	72.8	0.8

Student Information-Seeking Behavior

To learn students' preferences for using particular information sources, we asked students to indicate the sequence in which they consulted a range of information resources (table 18). The first step for most students was to consult their personal stores of technical information. (About 36% of Indian students, about 64% of the Japanese students, about 46% of the Russian students, and about 38% of the U.K. students consulted their personal stores of technical information first.) The second step for Indian students was to speak to faculty members (23.1%). For Japanese, Russian, and U.K. students the second step was to speak to other student (26.2%) (37.5%) (18.1%). Indian and Russian students spoke with faculty members (25.6%)(22.1%) as the third step. Japanese and U.K. students used literature resources found in a library (36.4)(21.2) as their third step.

About 97% of the Indian students used literature resources found in a library. However, about 11% of the Indian students did not consult a librarian during the search process. About 80% of the Japanese students used literature resources found in a library. However, about 90% of the Japanese students did not consult a librarian during the search process. Further, about 82% did not search (or have searched for them) an electronic (bibliographic) data base in the library during the search process.

About 97% of the Russian students used literature resources found in a library. However, about 93% of the Russian students did not consult a librarian during the search process. Further, about 99% of them did not search (or have searched for them) an electronic (bibliographic) data base in the library during the search process. About 88% of the U.K. students used literature resources found in a library. However, about 55% of the U.K. students did not consult a librarian during the search process. Further, about 30% did not search (or have searched for them) an electronic (bibliographic) data base in the library during the search process.

Table 18. Information Sources Used by Aerospace Engineering and Science Students in Problem Solving

Information Source	Used 1 st %	Used 2 nd %	Used 3 rd %	Used 4 th %	Used 5 th %	Used 6 th %	Used 7 th %	Did Not Use %
INDIA								
Used Personal Store Of Technical Information	35.9	7.7	20.5	23.1	7.7	0.0	---	5.1
Spoke With Students	0.0	17.9	15.4	28.2	28.2	0.0	---	10.3
Spoke With Faculty Members	28.2	23.1	25.6	17.9	2.6	0.0	---	2.6
Used Literature Resources (e.g., Conference Papers, Journal Articles, Technical Reports)	20.0	37.5	22.5	7.5	10.0	0.0	---	2.5
Spoke With A Librarian	0.0	0.0	0.0	0.0	2.7	0.1	---	89.2
Used Literature Resources Found In A Library	17.5	0.0	15.0	17.5	30.0	0.0	---	2.5
JAPAN								
Used Personal Store Of Technical Information	63.6	15.2	7.6	7.6	3.0	0.0	0.0	3.0
Spoke With Students	4.6	26.2	21.5	13.8	16.9	3.1	0.0	13.8
Spoke With Faculty Members	12.1	15.2	18.2	15.2	15.2	1.5	1.5	21.2
Used Literature Resources (e.g., Conference Papers, Journal Articles, Technical Reports)	15.2	22.7	13.6	19.7	4.5	0.0	0.0	24.2
Spoke With A Librarian	0.0	1.5	0.0	0.0	4.4	4.4	0.0	89.7
Used Literature Resources Found In A Library	1.5	18.2	36.4	18.2	6.1	0.0	0.0	19.7
Searched (Or Had Someone Search For Me) An Electronic (Bibliographic) Data Base In The Library	2.9	1.5	1.5	1.5	1.5	7.4	1.5	82.4
Used None Of The Above Steps	13.0	0.0	0.0	0.0	0.0	0.0	0.0	87.0

**Table 18. Information Sources Used by Aerospace
Engineering and Science Students in Problem Solving (concluded)**

Information Source	Used 1 st %	Used 2 nd %	Used 3 rd %	Used 4 th %	Used 5 th %	Used 6 th %	Used 7 th %	Did Not Use %
RUSSIA								
Used Personal Store Of Technical Information	45.7	19.1	11.7	8.5	1.1	0.0	3.2	10.6
Spoke With Students	19.8	37.5	13.5	8.3	4.2	1.0	1.0	14.6
Spoke With Faculty Members	23.2	17.9	22.1	10.5	4.2	1.1	0.0	21.1
Used Literature Resources (e.g., Conference Papers, Journal Articles, Technical Reports)	2.1	10.5	14.7	17.9	2.1	3.2	1.1	48.4
Spoke With A Librarian	0.0	2.3	0.0	2.3	1.1	1.1	0.0	93.1
Used Literature Resources Found In A Library	2.2	8.6	20.4	17.2	12.9	3.2	1.1	34.4
Searched (Or Had Someone Search For Me) An Electronic (Bibliographic) Data Base In The Library	0.0	1.3	0.0	0.0	0.0	0.0	0.0	98.7
Used None Of The Above Steps	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
U.K.								
Used Personal Store Of Technical Information	38.1	8.5	14.4	8.5	11.0	9.3	1.7	16.1
Spoke With Students	3.5	18.1	13.8	12.1	13.8	8.6	6.9	23.3
Spoke With Faculty Members	28.9	17.4	13.2	13.2	7.4	2.5	2.5	7.4
Used Literature Resources (e.g., Conference Papers, Journal Articles, Technical Reports)	15.8	24.2	19.2	18.3	10.0	2.5	0.0	10.0
Spoke With A Librarian	1.8	2.7	8.0	3.6	6.3	15.2	8.0	54.5
Used Literature Resources Found In A Library	4.2	12.7	21.2	22.0	22.0	5.1	0.1	11.9
Searched (Or Had Someone Search For Me) An Electronic (Bibliographic) Data Base In The Library	7.8	16.4	10.3	10.3	10.3	11.2	4.3	30.2
Used None Of The Above Steps	1.6	0.0	0.0	1.6	0.0	0.0	0.0	93.4

Use and Importance of Selected Information Sources

Student participants were also asked to indicate the frequency of their use of selected information sources and the importance of these sources (table 19) in meeting the information needs of aerospace engineer and science students. Students used their personal collections of information more than any other information source Indian students made the greatest use of

Table 19. Frequency of Use and Importance of Information Sources
Used to Meet Information Needs of Aerospace Engineering and Science Students
During the Most Recent School Term

Information Source	Use				Importance			
	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
	% ^a	% ^a	% ^a	% ^a	% ^a	% ^a	% ^a	% ^a
Your Personal Collection								
Of Information	97.5	71.5	58.1	75.8	80.0	50.7	43.9	60.0
Other Students	10.0	58.5	31.1	24.2	12.5	23.4	23.3	16.3
Faculty Members	43.6	28.6	13.2	32.6	45.0	55.9	28.0	33.8
Library	87.5	55.9	37.8	73.1	77.5	54.6	44.3	61.7
Librarian	15.4	5.2	2.9	10.6	2.6	7.8	5.7	13.4
Your Personal Contacts								
Within Industry	2.5	---	23.6	19.5	12.5	13.0	20.5	19.4
Your Personal Contacts At Government Laboratories	5.0	7.8	25.5	8.1	10.0	16.9	19.8	8.0

^aFrequency of use was measured using a 5-point scale, where 1 = never and 5 = always. Importance was measured using a 7-point scale, where 1 = very unimportant and 7 = very important. Percentages include combined "4" and "5" responses for use and combined "6" and "7" responses for importance.

their personal collections of information (97.5%) followed by the library (87.5%) and faculty members (43.6%). Japanese students used their personal collections of information (71.5%) most frequently followed by other students (58.5%) and the library (55.9%). Russian students used their personal collections of information (58.1%) most frequently followed by the library (37.8%) and other students (31.1%). U.K. students used their personal collections of information (75.8%) most frequently followed by the library (73.1%) and faculty members (32.6%).

Respondents in neither of the four groups made frequent personal use of contacts within industry and government laboratories. Russian (23.6%) and U.K. (19.5%) students made the most frequent use of personal contacts in industry. Japanese students reported "0" use of personal contacts in industry. Russian students (25.5%) made the most frequent use of personal contact in government laboratories.

Students were also asked to rate the importance of these information sources in meeting their information needs. For Indian students, the ranking of information sources by their importance mirrors their usage patterns. Personal collections of information received the highest importance ratings, followed by the library and faculty members. Although they also used personal collections of information more frequently than any other information source, Russian and Japanese students gave their highest importance ratings to the library with personal collections rated as second in importance. Japanese students gave the highest ratings to faculty members, followed by the library and personal collections of information. U.K. students gave their highest importance ratings to the library with personal collections rated as second in importance.

Use and Importance of Selected Information Products

Students were also asked about the frequency of their use of a variety of information products during the most recent school term and to rate the importance of these products in satisfying their information needs (table 20). For the entire sample, textbooks are among the most intensively used information products, particularly among undergraduate (i.e., Russia and Japan) students. Russian and Japanese students used textbooks more frequently than any other information product. Among Indian and British students, the majority of whom are graduate students, journal articles were the most frequently used information products.

Table 20 also reports the importance ratings to each information product. Russian, Japanese, and British students rated textbooks more importantly than any other information product. After textbooks, Russian students rated handbooks and journal articles most important. British students rated journal articles and conference/meeting papers highest. Japanese students rated conference/meeting papers and theses/dissertations as the second and third most important information products. Among Indian students, journal articles, textbooks, and conference/meeting papers were rated most important.

Use of Foreign and Domestically Produced Technical Reports

Students were asked if they use technical reports produced in the U.S. and foreign countries (table 21). U.S. NASA reports were heavily used by Indian (90%), British (73.3%), and Japanese (64.9%) students. A higher percentage of these students used NASA technical reports than they used the technical reports produced in their own countries. About 74% of the of Indian students used Indian NAL reports. In terms of frequency, they next used AGARD technical reports (55%) and British ARC and RAE technical reports (48.7%). About 53.4% of the Japanese students used Japanese NAL reports. In terms of frequency, they next used Indian NAL reports (88.3%) and AGARD technical reports (16.9%). About 47% of the Russian students used Russian TsAGI technical reports. In terms of frequency, they next used ESA technical reports (11.9%). About 55% of the U.K. students used British ARC and RAE technical reports followed by AGARD technical reports (52.6%). Dutch NLR technical reports and French ONERA technical reports were used infrequently by survey respondents.

**Table 20. Frequency of Use and Importance of Information Products
Used to Meet Information Needs of Aerospace Engineering and Science Students
During the Most Recent School Term**

Information Product	Use				Importance			
	India n=40	Japan n=77	Russia n=117	U.K. n=127	India n=40	Japan n=77	Russia n=117	U.K. n=127
	% ^a	% ^a	% ^a	% ^a	% ^a	% ^a	% ^a	% ^a
Abstracts	40.0	23.4	3.8	3.6	32.5	29.4	7.8	29.0
Conference/Meeting Papers	37.5	39.0	5.8	52.8	42.5	41.4	10.6	43.5
Journal Articles	85.0	31.0	21.7	66.7	85.0	29.4	39.5	56.8
Handbooks	20.5	11.7	62.6	0.8	20.0	17.3	59.6	27.4
Textbooks	80.0	65.0	75.7	61.6	62.5	44.0	67.0	59.7
Computer Programs/Documentation	22.5	19.5	25.5	32.5	22.5	17.4	31.7	32.0
Bibliographic, Numeric, Factual Data Bases	7.5	11.7	3.8	20.1	15.0	10.7	10.7	24.2
Theses/Dissertations	27.5	29.9	5.6	32.0	25.0	34.7	34.7	36.3
Technical Reports	35.0	15.6	9.5	47.6	38.5	18.7	18.7	40.7
Audio/Visual Materials	---	1.3	20.2	5.6	10.2	2.6	2.6	7.4
Foreign Language Technical Reports	---	23.4	12.2	6.4	7.5	26.7	26.7	9.6
Technical Translations	---	10.4	14.3	5.6	10.0	18.7	18.7	4.8
Patents	---	---	1.8	2.4	10.0	1.3	1.3	6.4
Industry Technical Reports	5.2	---	7.6	11.2	15.4	5.3	5.3	17.1
Drawings/Specifications	2.6	1.3	22.5	4.0	10.0	2.7	2.7	5.6
Preprints Or Deposited Manuscripts	7.5	1.3	2.9	3.3	37.5	4.0	4.0	4.2
Informal Information Products (e.g., Vendor/Supply Catalogs, Company Literature, Trade Journals/Magazines)	7.5	---	17.7	22.4	15.0	2.6	2.6	17.8

^aFrequency of use was measured using a 5-point scale, where 1 = never and 5 = always. Importance was measured using a 7-point scale, where 1 = very unimportant and 7 = very important. Percentages include combined "4" and "5" responses for use and combined "6" and "7" responses for importance.

Bilingual and Foreign Language Fluency

Table 22 reports students opinions concerning the importance of being bilingual relative to achieving career success. About 51% of the Indiana students reported that, in terms of achieving their career goals and aspirations, being bilingual is very important. About 57% of the Japanese students also report that it is very important to be bilingual as did 43.6% of the U.K. students. Almost three-quarters of the Russian students reported that, in terms of achieving their career goals and aspirations, being bilingual is very important. About one-quarter of the Indian and U.K. students reported that, in terms of achieving their career goals and aspirations, being bilingual is very unimportant.

**Table 21. Use of Foreign and Domestically Produced
Technical Reports by Aerospace Engineering and Science Students**

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Country/Organization	%	%	%	%
AGARD Reports	55.0	16.9	2.0	52.6
British ARC and RAE Reports	48.7	11.7	4.0	54.6
Dutch NLR Reports	7.9	2.6	2.0	14.9
ESA Reports (European Space Agency)	8.1	11.7	11.9	33.3
Indian NAL Reports	74.4	88.3	---	4.5
French ONERA Reports	28.9	6.5	4.0	16.5
German DFVLR, DLR, and MBB Reports	15.8	5.2	4.0	22.2
Japanese NAL Reports	9.9	53.2	3.0	7.1
Russian TsAGI Reports	2.6	1.3	47.1	4.4
U.S. NASA Reports	90.0	64.9	21.6	73.3

**Table 22. Importance of Being Bilingual in Achieving the Career Goals and Aspirations
of Aerospace Engineering and Science Students**

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Importance	% ^a	% ^a	% ^a	% ^a
Very Important	51.3	57.4	73.1	43.6
Of Average Importance	10.3	2.7	5.8	9.5
Very Unimportant	23.4	4.0	3.8	20.6

^aPercentages exclude students who reported that they are not bilingual.

Survey respondents were asked to provide information about their reading and speaking competencies in five languages (table 23). All of the Indian students read and speak English fluently. The mean reading and speaking abilities for English were $\bar{X} = 4.9$ and $\bar{X} = 4.7$, respectively. All of the Japanese students read and about 95% speak English fluently. The mean reading and speaking abilities for English were $\bar{X} = 3.1$ and $\bar{X} = 2.3$, respectively. About 81% of the Russian students read and about 80% speak English fluently. The mean reading and speaking abilities for English were $\bar{X} = 1.8$ and $\bar{X} = 2.7$, respectively. Indian students reported limited proficiency in German. About two-thirds of the Japanese students reported reading proficiency in German; about one-third reported speaking proficiency in German. About two-thirds of the U.K. students reported reading and speaking proficiency in French.

Table 23. Language Fluency of Aerospace Engineering and Science Students

Language	INDIA				JAPAN			
	Reading		Speaking		Reading		Speaking	
	% Read	Mean Ability ^a	% Speak	Mean Ability ^a	% Read	Mean Ability ^a	% Speak	Mean Ability ^a
English	100.0	4.9	100.0	4.7	100.0	3.1	94.7	2.3
French	9.1	1.7	9.1	1.0	27.4	1.2	17.6	1.2
German	21.6	1.8	19.9	1.6	63.0	1.4	32.3	1.4
Japanese	0.0	0.0	0.0	0.0	97.3	4.9	97.3	4.8
Russian	9.4	5.7	5.7	1.5	12.5	1.3	9.6	1.1
Other	0.0	4.4	0.0	5.0	96.1	1.0	0.0	0.0

^aA 5-point scale was used to measure fluency with "1" being passably and "5" being fluently; hence, the higher the average (mean), the greater the ability (fluency) of the student to read/speak the language.

Table 23. Language Fluency of Aerospace Engineering and Science Students (Concluded)

Language	RUSSIA				U.K.			
	Reading		Speaking		Reading		Speaking	
	% Read	Mean Ability ^a	% Speak	Mean Ability ^a	% Read	Mean Ability ^a	% Speak	Mean Ability ^a
English	81.1	1.8	79.5	4.8	100.0	4.8	99.2	4.7
French	23.8	2.0	23.5	2.5	68.3	2.5	68.2	2.2
German	28.7	2.5	25.5	2.9	35.3	2.9	35.3	2.7
Japanese	11.2	2.4	11.1	2.8	6.1	2.8	6.1	2.3
Russian	95.2	4.9	94.3	3.3	4.5	3.3	4.5	3.8
Other	13.7	1.0	12.8	2.9	28.4	2.9	28.4	2.0

^aA 5-point scale was used to measure fluency with "1" being passably and "5" being fluently; hence, the higher the average (mean), the greater the ability (fluency) of the student to read/speak the language.

Use of Computer and Information Technology and Electronic Networks

The use of computer technology to prepare written technical communications was investigated. Students were asked about their current and anticipated use of selected information technologies. Specifically, students were asked about their use of electronic networks, their use of electronic networks for specific purposes, and their use of electronic networks to exchange messages and files.

Computer Ownership and Use of Computers to Prepare Written Technical Communications

Ownership of a personal computer was highest among the Japanese (77.3%) and U.K. (64.8%) survey respondent (see table 24). About 3% of the Indian and about 11% of the Russian students owned a personal computer. Nearly all of the Indian, Japanese, and U.K. students we surveyed use computers when they prepare written technical communications. About 30% of the Russian students did not use computers when they prepare written technical communications.

Table 24. Computer Ownership/Use/Reasons For Nonuse By
Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Factor	%	%	%	%
Do you own a Personal Computer?				
Yes	2.5	77.3	11.4	64.8
No	97.5	22.7	88.6	35.2
Do You Use A Computer To Prepare Written Technical Communication?				
No	5.1	9.3	29.7	1.0
Yes	94.9	90.7	70.3	99.0
Sometimes	17.9	30.7	43.6	5.4
Frequently	23.1	30.7	17.8	24.2
Always	53.8	29.3	8.9	69.4
Your Reason(s) For Not Using A Computer?				
No/Limited Computer Access	0.0	28.6	73.3	0.0
Lack Of Knowledge/Skill Using A Computer	50.0	28.6	26.7	0.0
Prefer Not To Use A Computer	50.0	0.0	6.7	0.0
Other	0.0	42.9	13.3	0.0

Those Indian students who do not use computer technology to prepare written technical communications gave the following reasons for "non-use": lack of knowledge/skill using a computer (50%) and prefer not to use a computer (50%). Japanese students who do not use computer technology to prepare written technical communications gave the following reasons for "non-use": lack of knowledge/skill using a computer (28.6%) and no/limited computer access (28.6%). About 43% of the Japanese students who do not use computer technology to prepare written technical communications gave "other" as their reason for not using a computer. Russian students who do not use computer technology to prepare written technical communications gave the following reasons for "non-use": no/lack of access to computer technology (73.3%), lack of know-

ledge/skill using a computer (26.7%), prefer not to use a computer (7.6%), and "other" (13.3%) as their reasons for not using a computer.

Use of Electronic (Computer) Networks

Use of electronic networks was highest among U.K. (87.2%) and Indian (72.2%) students. Table 25 shows that about 41% of the Japanese and about 21% of Russian students report that they use electronic (computer) networks. About 68% of the Indian students and about 73% of the U.K. students reported that they personally use them. About 18% of the Russian and about 14% of the U.K. students use electronic (computer) networks through intermediaries.

Table 25. Use of Electronic (Computer) Networks by Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Factor	%	%	%	%
Do You Use Electronic (Computer) Networks?				
Yes	72.2	41.3	20.7	87.2
Yes, I Personally Use Them	67.2	36.0	2.8	72.8
Yes, I Use Them But Through An Intermediary	5.0	5.3	17.9	14.4
No	27.8	58.7	79.3	12.8
No, Because I Do Not Have Access To Electronic Networks	17.5	21.4	46.3	4.6
No, But I May Use Them In The Future	10.3	37.3	33.0	8.2

Table 26 lists the percentages of Indian, Japanese, Russian, and U.K. students who use electronic (computer) networks for 11 different functions. Indian and Japanese students made the greatest use of electronic networks to log onto computers for computational analysis or to use design tools (80.8%)(71%), electronic file transfer (78.6%)(64.5%), and for electronic mail (71.4%)(72.1). Russian students made the greatest use of electronic networks for electronic file transfer (80%) and for electronic bulletin boards or conference (78.9%) U.K. students made the greatest use of electronic networks to access/search the library's catalog (91.3%), to search electronic (bibliographic) data bases (79.8%), and for information search and data retrieval (76.6%). Electronic networks were used least by survey respondents to control laboratory instruments and design tools, ordering documents from the library, and preparing scientific and technical papers with colleagues at geographically distant sites.

Table 26. Uses of Electronic Networks by Aerospace Engineering and Science Students

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Purpose	%	%	%	%
Connect To Geographically Distant Sites	32.1	45.2	15.8	52.9
Electronic Mail	71.4	67.7	21.1	72.1
Electronic Bulletin Boards Or Conferences	16.7	31.6	78.9	23.7
Electronic File Transfer	78.6	64.5	80.0	54.0
Log On To Computers For Computational Analysis Or To Use Design Tools	80.8	71.0	35.0	71.8
Control Equipment Such As Laboratory Instruments Or Machine Tools	22.2	3.2	47.4	11.9
Access/Search The Library's Catalog	46.4	45.2	26.3	91.3
Order Documents From The Library	14.3	9.7	26.3	69.9
Search Electronic (Bibliographic) Data Bases	50.0	25.8	26.3	79.8
Information Search And Data Retrieval	42.9	45.2	50.0	76.6
Prepare Scientific And Technical Papers With Colleagues At Geographically Distant Sites	25.0	3.2	2.6	8.9

Students who use electronic (computer) networks to exchange messages or files do so with others at a wide array of locations (table 27). Seventy five percent of the Indian students use electronic networks to exchange files with members of their academic classes (see table 27). About 61% of the Japanese students use electronic networks to exchange messages with others in their academic community at the same geographic site who are not in their academic classes. About 37% of the Russian and about 58% of the U.K. students use electronic (computer) networks to exchange messages with members of their academic classes.

Use of Selected Information Technologies

Students were asked about their use and nonuse of a wide range of information technologies (table 28). Specifically, they were asked to indicate if they "already use it," "don't use it but may in the future," and "don't use it and doubt if I will." U.K. students reported the greatest use of computer-based information technologies such as electronic publishing, electronic mail, desk top publishing, and electronic bulletin boards and data bases. The Russian students reported the least use of computer-based information technologies.

**Table 27. Use of Electronic Networks by Aerospace
Engineering and Science Students to Exchange Messages or Files**

	India (n=40)	Japan (n=77)	Russia (n=117)	U.K. (n=127)
Exchange With --	%	%	%	%
Members Of Your Academic Classes	75.0	51.6	36.8	58.1
Other People In Your Academic Community At The SAME Geographic Site Who Are Not In Your Academic Classes	39.3	61.3	26.3	36.5
Other People In Your Academic Community At A DIFFERENT Geographic Site Who Are Not In Your Academic Classes	35.7	35.5	15.8	42.9
People Outside Of Your Academic Community	32.1	48.4	5.0	47.6

indicated that they do not yet participate in video and computer conferencing, but most many reported that they expect to use these technologies in the future. Most students do not expect to use audio tapes or motion picture tapes in the future.

FINDINGS

Readers should note that the samples from each country are small. Given this limitation, the data should be regarded as exploratory rather than conclusive. The results should be interpreted cautiously. The results, therefore, are not generalizable to (1) aerospace engineering and science students in each of the respective countries, (2) all aerospace engineering and science students, (3) to all engineering and science students.

1. The "average" student participant is a male; was a graduate student; was being educated as an engineer; was not a member of a professional student (national) engineering, scientific, or technical society; and was a citizen of the country where they attend school.
2. Undergraduates made their carer decisions while they were in high school.
3. A majority of student participants were influenced in their career selection by the following factor: "believe that a career in aerospace will provide a career with rewarding activities." Most student participants "feel about the same now as when they first made their career choice." Most student plan to work in industry upon graduation.

**Table 28. Use, Nonuse, and Potential Use of Information Technologies
by Aerospace Engineering and Science Students**

	Already Use It	Don't Use It, But May In Future	Don't Use It, And Doubt If Will
Information Technologies	%	%	%
INDIA			
Audio Tapes And Cassettes	15.8	50.0	34.2
Motion Picture Film	23.7	39.5	36.8
Videotape	41.0	38.5	20.5
Desktop/Electronic Publishing	32.4	56.8	10.8
Computer Cassettes/Cartridge Tapes	46.2	51.3	2.6
Electronic Mail	48.7	46.2	5.1
Electronic Bulletin Boards	7.7	64.1	28.2
FAX Or TELEX	17.9	64.1	17.9
Electronic Data Bases	33.3	56.4	10.3
Video Conferencing	2.6	71.1	26.3
Computer Conferencing	0.0	73.7	26.3
Micrographics And Microforms	30.8	51.3	17.9
JAPAN			
Audio Tapes And Cassettes	9.5	25.7	64.9
Motion Picture Film	2.7	20.2	77.3
Videotape	21.3	72.0	6.7
Desktop/Electronic Publishing	13.9	62.5	23.6
Computer Cassettes/Cartridge Tapes	31.5	35.6	32.9
Electronic Mail	26.7	64.0	9.3
Electronic Bulletin Boards	20.0	62.7	17.3
FAX Or TELEX	21.3	73.3	5.3
Electronic Data Bases	6.8	86.2	6.8
Video Conferencing	0.0	66.2	33.8
Computer Conferencing	0.0	70.3	29.7
Micrographics And Microforms	5.3	60.0	34.7

Table 28. Use, Nonuse, and Potential Use of Information Technologies
by Aerospace Engineering and Science Students (Concluded)

	Already Use It	Don't Use It, But May In Future	Don't Use It, And Doubt If Will
Information Technologies	%	%	%
RUSSIA			
Audio Tapes And Cassettes	25.2	27.2	47.6
Motion Picture Film	19.6	36.3	44.1
Videotape	20.4	58.3	21.4
Desktop/Electronic Publishing	17.1	62.9	20.0
Computer Cassettes/Cartridge Tapes	45.2	46.2	8.7
Electronic Mail	4.8	72.1	23.1
Electronic Bulletin Boards	4.8	66.3	28.8
FAX Or TELEX	10.6	68.3	21.2
Electronic Data Bases	17.6	65.7	16.7
Video Conferencing	2.9	56.7	40.4
Computer Conferencing	1.0	63.5	35.6
Micrographics And Microforms	13.5	49.0	37.5
U.K.			
Audio Tapes And Cassettes	16.3	29.3	54.5
Motion Picture Film	10.6	39.0	50.4
Videotape	31.5	48.4	20.2
Desktop/Electronic Publishing	64.8	31.2	4.1
Computer Cassettes/Cartridge Tapes	45.1	37.2	21.1
Electronic Mail	51.6	42.6	5.7
Electronic Bulletin Boards	18.2	66.1	15.7
FAX Or TELEX	69.1	29.3	1.6
Electronic Data Bases	51.6	43.4	4.9
Video Conferencing	4.1	68.3	27.6
Computer Conferencing	4.1	72.1	23.8
Micrographics And Microforms	26.5	42.2	31.4

4. In defining career success, most student respondents report that it is important to have the opportunity to explore new ideas about technology and to have the opportunity to work on complex technical problems.

5. Most student participants report that mastering information skills is important to career success. A majority of students had not received communication skills instruction. However, most student who received the instruction reported that the instruction was helpful.
6. On average 52% of the students' written technical communication involved collaborative writing and 54% of their written technical communication is required to be collaborative. Most students reported that group writing is as productive or more productive than writing alone.
7. Less than half of the student members received training directed solely at library skills.
8. Indian and U.K. students made greater use of a library (i.e., made more visits) than did Japanese and Russian students. The mean effectiveness of the information the students received from the library ranged from a low of $\bar{X} = 5.2$ to a high of $\bar{X} = 5.6$. Students reported "I had no information needs" and "my information needs were more easily met some other way" as the reasons most frequently given for not using a library.
9. Those students who used electronic (bibliographic) data bases did all or most of their own searches.
- 10 All students consulted their own personal stores of technical information as the first step in obtaining information used in problem solving.
11. Personal collections of technical information and a library were the most frequently used and were considered to be the most important information sources by most student respondents. Textbooks and journal articles were the most frequently used and were considered to be the most important information products by most student respondents.
12. With the exception of the Russian students, survey respondents made considerable use of NASA technical reports.
13. Most students reported that being bilingual is important in terms of achieving their career goals and aspirations.
14. Although the ability to do so varied for the four student samples, most student reported that they could read and speak English.
15. More Japanese and U.K. students owned a personal computer than did the Indian and Russian students. Most students used a computer to prepare written technical communications. No/limited computer access and lack of knowledge/skill using a computer were the reasons reported most often for not using a computer.
16. More Indian and U.K. students used electronic (computer) networks than did Japanese and Russian students. Most students used electronic networks for electronic mail and electronic file transfer.

CONCLUDING REMARKS

We interpret the survey data to indicate that there are two major differences between students respondents. The first difference is rooted in the types of organizations that they plan to join upon graduation. The second is the structure of the academic experience which defines students' information needs and the strategies employed for meeting them. Undergraduate students expect to work in industry, at both the national and multi-national levels. The high importance that undergraduate students placed on goals which define career success through advancement within the organization are consistent with these expectations. Graduate students are more likely than undergraduates to aspire to work in academia. The high importance ratings that graduate students assigned to developing a professional reputation through written and oral communication of their ideas is consistent with this goal.

There were also clear differences in the information seeking habits of undergraduate and graduate students. Although undergraduates are at least as well trained in information seeking skills as graduate students are, undergraduate students apply these skills less often. Industry recommendations for improvement of engineering education curricula consistently point to the need for better training in skills related to locating, using, and communicating STI. Nevertheless, it appears that undergraduate students -- those students who aspire to work in industry -- may lack the opportunity to hone these skills by applying them routinely during the course of their education. Because undergraduate students can satisfy their information needs through informal channels/sources and by mainly using textbooks and other classroom materials, they will probably attempt to apply this behavior, upon graduation, to "the world of work". When they begin their careers, these students will be expected to locate, using, and communicate information in a completely different environment. Reliance on classroom-type materials, such as textbooks, and strategies, such as discussions with faculty members, may simply be inadequate and possibly even unacceptable for this new environment.

ACKNOWLEDGEMENTS

The authors acknowledge the Council on Library Resources (CLR) and its president, Dr. W. David Penniman, for providing the funds used to analyze these data. The authors also acknowledge the help and assistance of Dr. Robert A. Kilgore in making the student surveys possible. Finally, we thank Professor M.A. Rama Swamy at the Indian Institute of Science, Professor Hirotohi Kubota at the University of Toyko, Dr. Sergey M. Novikov formerly at the Central Aero-Hydrodynamics Institute, Professor J.L. Stollery and Mr. John Blagden at Cranfield University, and Professor Michael Goodyer at the University of Southampton for helping to make the Phase 4 students surveys possible.

REFERENCES

- Black, K.M. (1994). "An Industry View of Engineering Education." *Journal of Engineering Education*, 83:1, 26-28.
- Devon, R. (1985). "Industry's Advice for the First Two Years." *Engineering Education*, 76:2, 112-114.
- Evans, D.L., G.C. Beakley, P.E. Crouch, and G.T. Yamaguchi. (1993). "Attributes of Engineering Graduates and Their Impact on Curriculum Design." *Journal of Engineering Education*, 82:4, 203-211.
- Garry, F.W. (1986). "A Business Look at Engineering Education." *Engineering Education*, 76:4, 203-205.
- Katz, S. (1993). "The Entry-Level Engineer: Problems in Transition from Student to Professional." *Journal of Engineering Education*, 82:3, 171-174.
- Mailloux, E.N. (1989). "Engineering Information Systems." In *The Annual Review of Information Science and Technology*. Vol. 25. M.E. Williams, ed. Elsevier Science Publishers, Amsterdam, 239-266.
- Morrow, R.M. (1994). "Issues Facing Engineering Education." *Journal of Engineering Education*, 83:1, 15-18.
- Pinelli, T.E., J.M. Kennedy, and R.O. Barclay. (1991). "The NASA/DoD Aerospace Knowledge Research Project." *Government Information Quarterly*, 8:2, 219-233.
- Strother, J.B. (1992). "Reality vs Expectations: Practicing Engineers vs Engineering Students." Paper presented at International Professional Communication Conference. Santa Fe, NM.
- Sylvester, N.D. (1980). "Engineering Education Must Improve the Communication Skills of its Graduates." *Engineering Education*, 70, 739-740.

APPENDIX A: PROJECT FACT SHEET

NASA/DoD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT

Fact Sheet

The process of producing, transferring, and using scientific and technical information (STI), which is an essential part of aerospace research and development (R&D), can be defined as *Aerospace Knowledge Diffusion*. Studies tell us that timely access to STI can increase productivity and innovation and help aerospace engineers and scientists maintain and improve their professional skills. These same studies indicate, however, that we know little about aerospace knowledge diffusion or about how aerospace engineers and scientists find and use STI. To learn more about this process, we have organized a research project to study knowledge diffusion. Sponsored by NASA and the Department of Defense (DoD), the *NASA/DoD Aerospace Knowledge Diffusion Research Project* is being conducted by researchers at the NASA Langley Research Center, the Indiana University Center for Survey Research, and Rensselaer Polytechnic Institute. This research is endorsed by several aerospace professional societies including the AIAA, RAeS, and DGLR and has been sanctioned by the AGARD and AIAA Technical Information Panels.

This 4-phase project is providing descriptive and analytical data about the flow of STI at the individual, organizational, national, and international levels. It is examining both the channels used to communicate STI and the social system of the aerospace knowledge diffusion process. Phase 1 investigates the information-seeking habits and practices of U.S. aerospace engineers and scientists, in particular their use of government-funded aerospace STI. Phase 2 examines the industry-government interface and emphasizes the role of the information intermediary in the knowledge diffusion process. Phase 3 concerns the academic-government interface and emphasizes the information intermediary-faculty-student interface. Phase 4 explores the information-seeking behaviors of non-U.S. aerospace engineers and scientists from Western European nations, India, Israel, Japan, and the former Soviet Union.

The results of this research project will help us to understand the flow of STI at the individual, organizational, national, and international levels. The findings can be used to identify and correct deficiencies; to improve access and use; to plan new aerospace STI systems; and should provide useful information to R&D managers, information managers, and others concerned with improving access to and utilization of STI. These results will contribute to increasing productivity and to improving and maintaining the professional competence of aerospace engineers and scientists. The results of our research are being shared freely with those who participate in the study.

Dr. Thomas E. Pinelli
Mail Stop 180A
NASA Langley Research Center
Hampton, VA 23681-0001
(804) 864-2491
Fax (804) 864-8311
T.E.Pinelli@larc.nasa.gov

Dr. John M. Kennedy
Center for Survey Research
Indiana University
Bloomington, IN 47405
(812) 855-2573
Fax (812) 855-2818
kennedy@isrmail.soc.indiana.edu

Rebecca O. Barclay
Dept. of Language, Lit. & Communication
Rensselaer Polytechnic Institute
Troy, NY 12180
(804) 399-5666
Fax (804) 397-4635
barclay@infi.net

APPENDIX B: SURVEY INSTRUMENT

Technical Communications in Aerospace

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to: (Circle number)

	Very Unimportant				Very Important				Don't Know
1 Have the opportunity to explore new ideas about technology or systems	1	2	3	4	5	6	7		8
2 Advance to a high-level staff technical position	1	2	3	4	5	6	7		8
3 Have the opportunity to work on complex technical problems	1	2	3	4	5	6	7		8
4 Work on projects that utilize the latest theoretical results in your specialty	1	2	3	4	5	6	7		8
5 Work on projects that require learning new technical knowledge	1	2	3	4	5	6	7		8
6 Establish a reputation outside your organization as an authority in your field	1	2	3	4	5	6	7		8
7 Receive patents for your ideas	1	2	3	4	5	6	7		8
8 Publish articles in technical journals	1	2	3	4	5	6	7		8
9 Communicate your ideas to others in your profession through papers delivered at professional society meetings	1	2	3	4	5	6	7		8
10 Be evaluated on the basis of your technical contributions	1	2	3	4	5	6	7		8
11 Become a manager or director in your line of work	1	2	3	4	5	6	7		8
12 Plan and coordinate the work of others	1	2	3	4	5	6	7		8
13 Advance to a policy-making position in management	1	2	3	4	5	6	7		8
14 Plan projects and make decisions affecting the organization	1	2	3	4	5	6	7		8
15 Be the technical leader of a group of less experienced professionals	1	2	3	4	5	6	7		8

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice? (Circle number)

	Very Unimportant							Very Important	Not Applicable
1 Your parents encouraged your area of study/major	1	2	3	4	5	6	7		9
2 Other family members encouraged your area of study/major	1	2	3	4	5	6	7		9
3 Teachers encouraged your area of study/major	1	2	3	4	5	6	7		9
4 You feel that a career in your major/area of study will lead to financial security . . .	1	2	3	4	5	6	7		9
5 You feel that a career in your major/area of study will provide a career with many rewarding activities	1	2	3	4	5	6	7		9
6 Information on the career opportunities available in your major/area of study . . .	1	2	3	4	5	6	7		9
7 Other important factors (Please specify) _____									

3. When did you first decide on your area of study/major? (Circle number)

- 1 While still in elementary school
- 2 While in high school (or equivalent)
- 3 When you started college (or equivalent)
- 4 After starting college (or equivalent)
- 5 Other (Please specify) _____

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path?
Would you say: (Circle ONLY one)

- 1 I am more happy about my career choice now than when I first made it
- 2 I feel about the same now as when I first made it
- 3 I am less happy about my career choice now than when I first made it

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will be for you to: (Circle number)

	Very Unimportant					Very Important					Don't Know
1 Effectively communicate technical information in writing	1	2	3	4	5	6	7				8
2 Effectively communicate technical information orally	1	2	3	4	5	6	7				8
3 Have a knowledge and understanding of engineering/science information resources and materials	1	2	3	4	5	6	7				8
4 Be able to search electronic (bibliographic) data bases	1	2	3	4	5	6	7				8
5 Know how to use a library that contains engineering/science information resources and materials	1	2	3	4	5	6	7				8
6 Effectively use computer, communication, and information technology	1	2	3	4	5	6	7				8

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in: (Circle number)

	Yes	No	No Instruction Available
1 Technical writing/communication	1	2	8
2 Speech/oral communication	1	2	8
3 Using a library that contains engineering/science information resources and materials	1	2	8
4 Using engineering/science information resources and materials	1	2	8
5 Searching electronic (bibliographic) data bases	1	2	8
6 Using computer, communication, and information technology	1	2	8

7. If you received training or instruction in any of the following, was it helpful?
(Circle number)

			Not					Very	Don't	Did Not
			Helpful					Helpful	Know	Receive
										Training
1	Technical writing/communication . . .	1	2	3	4	5	6	7	8	10
2	Speech/oral communication	1	2	3	4	5	6	7	8	10
3	Using a library that contains engineering /science information resources and materials	1	2	3	4	5	6	7	8	10
4	Using engineering/science information resources and materials	1	2	3	4	5	6	7	8	10
5	Searching electronic (bibliographic) data bases	1	2	3	4	5	6	7	8	10
6	Using computer, communication, and information technology	1	2	3	4	5	6	7	8	10

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. What percentage of your written technical communication involves collaborative writing (i.e., writing as a member of a group)?

_____ % (If 100% of your writing is done alone, go to Question 11.)

9. If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?

_____ %

10. In general, do you find writing as part of a group more or less productive (i.e. quantity/quality) than writing alone? (Circle number)

- 1 Less productive than writing alone
- 2 About as productive as writing alone
- 3 More productive than writing alone

11. Do you use a computer to prepare written technical communication?
(Circle number)

- 1 Never
 - 2 Sometimes
 - 3 Frequently
 - 4 Always
- } Go to Question 13.

12. If NEVER, which one of the following best explains your reasons for non-use?
(Circle numbers)

- 1 No or limited computer access
- 2 Lack of knowledge/skill using a computer
- 3 Prefer not to use a computer
- 4 Other (Please specify) _____

13. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce (i.e., quality/quantity) written technical communication? (Circle all that apply.)

	Does not Impede					Greatly Impedes		Don't Know
1 Defining the purpose of the communication	1	2	3	4	5	6	7	8
2 Assessing the needs of the reader	1	2	3	4	5	6	7	8
3 Preparing/presenting information in an organized manner	1	2	3	4	5	6	7	8
4 Developing paragraphs (introductions, transitions, and conclusions)	1	2	3	4	5	6	7	8
5 Writing grammatically correct sentences	1	2	3	4	5	6	7	8
6 Notetaking and quoting	1	2	3	4	5	6	7	8
7 Editing and revising	1	2	3	4	5	6	7	8
8 Other (Please specify) _____								

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information. (Circle number)

Information Technologies	I already use it	I don't use it, but may in the future	I don't use it and doubt if I will
1 Audio tapes and cassettes	1	2	3
2 Motion picture film	1	2	3
3 Video tape	1	2	3
4 Desktop /electronic publishing	1	2	3
5 Computer cassette/cartridge tapes	1	2	3
6 Electronic mail	1	2	3
7 Electronic bulletin boards	1	2	3
8 FAX or TELEX	1	2	3
9 Electronic data bases	1	2	3
10 Video conferencing	1	2	3
11 Computer conferencing	1	2	3
12 Micrographics & microforms	1	2	3

15. Do you ever use electronic (computer) networks? (Circle number)

- | | | |
|--|---|--------------------|
| 1 Yes, I personally use them | } | Go to Question 18. |
| 2 Yes, I use them but through an intermediary | | |
| 3 No | | |
| 4 No because I do not have access to electronic networks | | |
| 5 No but may use them in the future | | |

If you answered "no" to Question 15, please go to Question 18. If you answered "yes" to Question 15, please continue to Question 16.

16. Do you use electronic networks for the following purposes? (Circle number)

	Yes	No
1 To connect to geographically distant sites	1	2
2 For electronic mail	1	2
3 For electronic bulletin boards or conferences	1	2
4 For electronic file transfer	1	2
5 To log into computers for such things as computational analysis or to use design tools	1	2
6 To control equipment such as laboratory instruments or machine tools	1	2
7 To access/search the library's catalogue	1	2
8 To order documents from the library	1	2
9 To search electronic (bibliographic) data bases	1	2
10 For information search and data retrieval	1	2
11 To prepare scientific and technical papers with colleagues at geographically distant sites	1	2

17. Do you exchange electronic messages or files with: (Circle number)

	Yes	No
1 Members of your academic classes	1	2
2 Other people in your academic community at the SAME geographic site who are not in your academic classes	1	2
3 Other people in your academic community at a DIFFERENT geographic site who are not in your academic classes	1	2
4 People outside of your academic community	1	2

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

_____ number of times

If you answered "0" times to Question 18, please go to Question 20. If you answered "1 or more" times to Question 18, please continue to Question 19.

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs? (Circle number) } Go to Question 21.

Very Ineffective Very Effective Don't Know
 1 2 3 4 5 6 7 8

20. Which of the following statements best describes your reasons for not using a library during this current school term? (Circle ALL that apply)

	Yes	No
1 I had no information needs	1	2
2 My information needs were more easily met some other way	1	2
3 Tried the library once or twice before but I couldn't find the information I needed	1	2
4 The library is physically too far away	1	2
5 The library staff is not cooperative or helpful	1	2
6 The library staff does not understand my information needs	1	2
7 The library did not have the information I need	1	2
8 I have my own personal library and do not need another library	1	2
9 The library is too slow in getting the information I need	1	2
10 We have to pay to use the library	1	2
11 We are discouraged from using the library	1	2

21. As part of your academic preparation, have you received or participated in the following library activities? (Circle ALL that apply)

	Yes	No	Not Available	Don't Know
1 Library tour	1	2	6	8
2 Library presentation as part of academic orientation	1	2	6	8
3 Library orientation as part of an engineering/ science course	1	2	6	8
4 Library skill/use course (bibliographic instruction)	1	2	6	8
5 Library skill/use course in engineering/science information resources and materials	1	2	6	8
6 Library instruction for end-user searching of electronic (bibliographic) data bases	1	2	6	8

22. Which ONE of the following BEST characterizes your use of electronic (bibliographic) data bases? (Circle ONLY ONE number)

- 1 I do **all** searches myself
- 2 I do **most** searches myself
- 3 I do **half** by myself and **half** through a librarian
- 4 I do **most** searches through a librarian
- 5 I do **all** searches through a librarian
- 6 I do **not use** electronic data bases
- 7 I do not have access to electronic data bases

These questions ask about the use and importance of information to engineering/science students.

23. How OFTEN during this current school term have you used the following information sources to meet your engineering/science information needs? (Circle numbers)

	Never	Seldom	Sometimes	Frequently	Always	Not Available
1 Your personal collection of information	1	2	3	4	5	6
2 Other students	1	2	3	4	5	6
3 Faculty members	1	2	3	4	5	6
4 Library	1	2	3	4	5	6
5 Librarian	1	2	3	4	5	6
6 Your personal contacts within industry	1	2	3	4	5	6
7 Your personal contacts at government laboratories . . .	1	2	3	4	5	6

24. How OFTEN during this current school term have you used the following information products to meet your engineering/science information needs? (Circle numbers)

	Never	Seldom	Sometimes	Frequently	Always	Not Available
1 Abstracts	1	2	3	4	5	6
2 Conference/meeting papers	1	2	3	4	5	6
3 Journal articles	1	2	3	4	5	6
4 Handbooks	1	2	3	4	5	6
5 Textbooks	1	2	3	4	5	6
6 Computer programs and documentation	1	2	3	4	5	6
7 Bibliographic, numeric, factual data bases	1	2	3	4	5	6
8 Theses/dissertations	1	2	3	4	5	6
9 Technical reports	1	2	3	4	5	6
10 Audio/visual materials . . .	1	2	3	4	5	6
11 Foreign language technical reports	1	2	3	4	5	6
12 Technical translations . . .	1	2	3	4	5	6
13 Patents	1	2	3	4	5	6
14 Industry technical reports .	1	2	3	4	5	6
15 Drawings/specifications . .	1	2	3	4	5	6
16 Preprints or deposited manuscripts	1	2	3	4	5	6
17 Informal information products e.g., vendor/supply catalogs, company literature, trade journals/magazines)	1	2	3	4	5	6

25. How IMPORTANT are the following information sources in meeting your engineering/science information needs? (Circle numbers)

	Very Unimportant					Very Important			Not Available
1 Your personal collection of information	1	2	3	4	5	6	7		8
2 Other students	1	2	3	4	5	6	7		8
3 Faculty members	1	2	3	4	5	6	7		8
4 Library	1	2	3	4	5	6	7		8
5 Librarian	1	2	3	4	5	6	7		8
6 Your personal contacts within industry	1	2	3	4	5	6	7		8
7 Your personal contacts at government laboratories	1	2	3	4	5	6	7		8

26. How IMPORTANT are the following information products in meeting your engineering/science information needs? (Circle numbers)

	Very Unimportant					Very Important			Not Available
1 Abstracts	1	2	3	4	5	6	7		8
2 Conference/meeting papers	1	2	3	4	5	6	7		8
3 Journal articles	1	2	3	4	5	6	7		8
4 Handbooks	1	2	3	4	5	6	7		8
5 Textbooks	1	2	3	4	5	6	7		8
6 Computer programs and documentation	1	2	3	4	5	6	7		8
7 Bibliographic, numeric, factual data bases	1	2	3	4	5	6	7		8
8 Theses/dissertations	1	2	3	4	5	6	7		8
9 Technical reports	1	2	3	4	5	6	7		8
10 Audio/visual materials	1	2	3	4	5	6	7		8
11 Foreign language technical reports	1	2	3	4	5	6	7		8
12 Technical translations	1	2	3	4	5	6	7		8
13 Patents	1	2	3	4	5	6	7		8
14 Industry technical reports	1	2	3	4	5	6	7		8
15 Drawings/specifications	1	2	3	4	5	6	7		8
16 Preprints or deposited manuscripts	1	2	3	4	5	6	7		8
17 Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	1	2	3	4	5	6	7		8

27. Do you use the following technical reports in meeting your engineering/science information needs? (Circle numbers)

	Yes	No	Don't Have Access
1 AGARD reports	1	2	6
2 British ARC and RAE reports	1	2	6
3 Dutch NLR reports	1	2	6
4 ESA reports	1	2	6
5 Indian NAL reports	1	2	6
6 French ONERA reports	1	2	6
7 German DFVLR, DLR, and MBB reports	1	2	6
8 Japanese NAL reports	1	2	6
9 Russian TsAGI reports	1	2	6
10 U.S. NASA reports	1	2	6

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment? Please sequence these items (e.g., #1, #2, #3, #4, #5) and mark an X beside the step(s) you DID NOT USE.

Sequence

- ___ Used my personal store of technical information
- ___ Spoke with other students
- ___ Spoke with faculty members
- ___ Used literature resources (e.g., conference papers, journal articles, technical reports)
- ___ Spoke with a librarian
- ___ Used literature resources found in a library
- ___ Used none of the above steps
- ___ Searched (or had someone search for me) an electronic (bibliographic) database in the library.

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender? (Circle number)

- 1 Female
- 2 Male

30. What is your educational status? (Circle number)

- 1 Freshman
- 2 Sophomore
- 3 Junior
- 4 Senior
- 5 Graduate
- 6 Other (Please specify) _____

31. Is your education primarily as:

- 1 An engineer
- 2 A scientist
- 3 Something else
(Please specify) _____

32. What is your native language?

Please specify _____

33. What is your native country?

Please specify _____

34. Are you a citizen of the country where you are attending school? (Circle number)

- 1 Yes
- 2 No

35. How well do you read the following languages? (Circle numbers)

	Passably					Fluently	Do not Read This Language
1 English	1	2	3	4	5		6
2 French	1	2	3	4	5		6
3 German	1	2	3	4	5		6
4 Japanese	1	2	3	4	5		6
5 Russian	1	2	3	4	5		6
6 Other (please specify) _____							

36. How well do you speak the following languages? (Circle numbers)

	Passably					Fluently	Do not Speak This Language
1 English	1	2	3	4	5		6
2 French	1	2	3	4	5		6
3 German	1	2	3	4	5		6
4 Japanese	1	2	3	4	5		6
5 Russian	1	2	3	4	5		6
6 Other (please specify) _____							

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual (i.e., read and speak more than one language)? (Circle number)

Very Unimportant						Very Important		Am Not Bilingual	Don't Know
1	2	3	4	5	6	7		8	9

38. In what type of organization do you hope to work after graduation? (Circle number)

- 1 Academic
- 2 Government
- 3 Industry (national)
- 4 Industry (multi-national)
- 5 NOT for profit
- 6 Other (please specify) _____

39. When you were growing up, do you think your family's income was: (Circle number)

- 1 Much higher than that of most families in your native country
- 2 Higher than that of most families in your native country
- 3 About equal to the average family income in your native country
- 4 Lower than that of most families in your native country
- 5 Much lower than that of most families in your native country
- 6 I cannot compare my family's income with incomes of other families

40. Do you own a personal computer? (Circle number)

- 1 Yes
- 2 No

41. As a high school student, how often did you use your: (Circle number)

	Never	Seldom	Sometimes	Frequently	Always	Not Available
2 High school library	1	2	3	4	5	6
3 Public library	1	2	3	4	5	6

42. As a technology major, about how many hours a week (exclusive of classroom and course assignments) do you spend reading (keeping current with) the professional literature associated with your discipline?

_____ hours each week

43. Are you a member of a professional student (national) engineering, scientific, or technical society? (Circle number)

- 1 Yes
- 2 No

APPENDIX C: CODEBOOKS

INDIA

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Have the opportunity to explore new ideas about technology or systems	0.0	0.0	5.1	0.0	12.8	17.9	64.1
Advance to a high-level staff technical position	5.0	2.5	7.5	10.0	30.0	25.0	20.0
Have the opportunity to work on complex technical problems	0.0	0.0	2.7	13.5	10.8	18.9	54.1
Work on projects that utilize the latest theoretical results in your specialty	0.0	0.0	2.5	12.5	25.0	37.5	22.5
Work on projects that require learning new technical knowledge	0.0	0.0	7.5	2.5	22.5	27.5	40.0
Establish a reputation outside your organization as an authority in your field	2.5	2.5	5.0	17.5	7.5	22.5	42.5
Receive patents for your ideas	10.3	5.1	15.4	20.5	12.8	17.9	17.9
Publish articles in technical journals	0.0	2.5	2.5	12.5	7.5	37.5	37.5
Communicate your ideas to others in your profession through papers delivered at professional society meetings	2.5	2.5	7.5	15.0	15.0	22.5	35.0
Be evaluated on the basis of your technical contributions	2.5	2.5	2.5	15.0	10.0	35.0	32.5
Become a manager or director in your line of work	15.0	7.5	10.0	15.0	30.0	7.5	15.0
Plan and coordinate the work of others	7.5	10.0	7.5	15.0	25.0	20.0	15.0
Advance to a policy-making position in management	12.8	5.1	15.4	17.9	17.9	10.3	20.5
Plan projects and make decisions affecting the organization	7.9	0.0	15.8	15.8	23.7	15.8	21.1
Be the technical leader of a group of less experienced professionals	13.2	10.5	18.4	18.4	18.4	13.2	7.9

India

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice?

	Very Unimportant					Very Important		NA
	1	2	3	4	5	6	7	9
	%	%	%	%	%	%	%	%
Your parents encouraged your area of study/major	5.0	17.5	20.0	12.5	0.0	15.0	22.5	7.5
Other family members encouraged your area of study/major	15.0	22.5	7.5	15.0	12.5	5.0	7.5	15.0
Teachers encouraged your area of study/major	12.5	10.0	10.0	10.0	7.5	15.0	25.0	10.0
You feel that a career in your major/area of study will lead to financial security	10.0	5.0	10.0	15.0	15.0	17.5	12.5	15.0
You feel that a career in your major/area of study will provide a career with many rewarding activities	0.0	2.5	5.0	12.5	10.0	25.0	35.0	10.0
Information on the career opportunities available in your major/area of study	10.0	2.5	2.5	22.5	12.5	20.0	30.0	0.0

3. When did you first decide on your area of study/major?

While still in elementary school	2.5%
While in high school (or equivalent)	17.5%
When you started college (or equivalent)	30.0%
After starting college (or equivalent)	35.0%
Other	15.0%

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path?

I am more happy about my career choice now than when I first made it	45.0%
I feel about the same now as when I first made it	42.5%
I am less happy about my career choice now than when I first made it	12.5%

India

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Effectively communicate technical information in writing	0.0	0.0	2.5	2.5	5.0	30.0	60.0
Effectively communicate technical information orally	0.0	2.5	2.5	7.5	10.0	25.0	52.5
Have a knowledge and understanding of engineering/science information resources and materials	0.0	0.0	2.5	5.0	5.0	30.0	57.5
Be able to search electronic (bibliographic) data bases	3.0	3.0	12.1	15.2	24.2	24.2	18.2
Know how to use a library that contains engineering/science information resources and materials	0.0	0.0	2.6	5.1	10.3	28.2	53.8
Effectively use computer, communication, and information technology	0.0	0.0	2.5	2.5	7.5	17.5	70.0

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in:

	Yes 1 %	No 2 %	No Instruction Available 8 %
Technical writing/communication	36.8	52.6	10.5
Speech/oral communication	23.1	61.5	15.4
Using a library that contains engineering/science information resources and materials	33.3	48.7	17.9
Using engineering/science information resources and materials	43.6	38.5	17.9
Searching electronic (bibliographic) data bases	17.9	61.5	20.5
Using computer, communication, and information technology	64.1	25.6	10.3

India

7. If you received training or instruction in any of the following, was it helpful?

	Not Helpful 1 %	2 %	3 %	4 %	5 %	6 %	Very Helpful 7 %	No Training 10 %
Technical writing/communication	0.0	0.0	5.3	5.3	2.6	5.3	18.4	63.2
Speech/oral communication	0.0	0.0	0.0	2.7	2.7	8.1	10.8	75.7
Using a library that contains engineering/science information resources and materials	0.0	0.0	0.0	2.6	2.6	15.8	15.8	63.2
Using engineering/science information resources and materials	0.0	0.0	0.0	2.9	2.9	25.7	8.6	60.0
Searching electronic (bibliographic) data bases	2.7	0.0	2.7	2.7	0.0	10.8	2.7	78.4
Using computer, communication, and information technology	0.0	0.0	5.3	13.2	5.3	7.9	31.6	36.8

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. What percentage of your written technical communication involves collaborative writing?

0 percent	14.7%
1 through 25 percent	8.7%
26 through 50 percent	35.3%
51 through 75 percent	17.6%
76 through 99 percent	8.7%
100 percent	14.7%

9. If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?

0 percent	0.0%
1 through 25 percent	16.0%
26 through 50 percent	44.0%
51 through 75 percent	24.0%
76 through 99 percent	8.0%
100 percent	8.0%

10. In general, do you find writing as part of a group more or less productive than writing alone?

Less productive than writing alone	20.0%
About as productive as writing alone	36.7%
More productive than writing alone	43.3%

11. Do you use a computer to prepare written technical communication?

Never	5.1%
Sometimes	17.9%
Frequently	23.1%
Always	53.8%

12. Which of the following best explains your reasons for non-use?

No or limited computer access	0.0%
Lack of knowledge/skill using a computer	50.0%
Prefer not to use a computer	50.0%
Other	0.0%

India

13. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce written technical communication?

	Does not Impede						Greatly Impedes
	1	2	3	4	5	6	7
	%	%	%	%	%	%	%
Defining the purpose of the communication	18.2	15.2	0.0	21.2	9.1	9.1	27.3
Assessing the needs of the reader	13.8	3.4	3.4	34.5	13.8	17.2	13.8
Preparing/presenting information in an organized manner	22.9	14.3	2.9	14.3	8.6	5.7	31.4
Developing paragraphs (introductions, transitions, and conclusions)	14.3	14.3	20.0	8.6	14.3	14.3	14.3
Writing grammatically correct sentences	31.4	5.7	11.4	25.7	5.7	8.6	11.4
Notetaking and quoting	18.8	6.3	6.3	34.4	21.9	3.1	9.4
Editing and revising	16.1	6.5	16.1	12.9	19.4	12.9	16.1

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information.

	I already use it	I don't use it, but may in the future	I don't use it and doubt if I will
	1	2	3
	%	%	%
Audio tapes and cassettes	15.8	50.0	34.2
Motion picture film	23.7	39.5	36.8
Video tape	41.0	38.5	20.5
Desktop/electronic publishing	32.4	56.8	10.8
Computer cassette/cartridge tapes	46.2	51.3	2.6
Electronic mail	48.7	46.2	5.1
Electronic bulletin boards	7.7	64.1	28.2
FAX or TELEX	17.9	64.1	17.9
Electronic data bases	33.3	56.4	10.3
Video conferencing	2.6	71.1	26.3
Computer conferencing	0.0	73.7	26.3
Micrographics & microforms	30.8	51.3	17.9

India

15. Do you ever use electronic networks?

Yes, I personally use them	67.5%
Yes, I use them but through an intermediary	5.0%
No	10.0%
No, because I do not have access	7.5%
No, but I may use them in the future	10.0%

16. Do you use electronic networks for the following purposes?

	Yes 1 %	No 2 %
To connect to geographically distant sites	32.1	67.9
For electronic mail	71.4	28.6
For electronic bulletin boards or conferences	16.7	83.3
For electronic file transfer	78.6	21.4
To log into computers for such things as computational analysis or to use design tools	80.8	19.2
To control equipment such as laboratory instruments or machine tools	22.2	77.8
To access/search the library's catalogue	46.4	53.6
To order documents from the library	14.3	85.7
To search electronic (bibliographic) data bases	50.0	50.0
For information search and data retrieval	42.9	57.1
To prepare scientific and technical papers with colleagues at geographically distant sites	25.0	75.0

17. Do you exchange electronic messages or files with:

	Yes 1 %	No 2 %
Members of your academic classes	75.0	25.0
Other people in your academic community at the same geographic site who are not in your academic classes	39.3	60.7
Other people in your academic community at a different geographic site who are not in your academic classes	35.7	64.3
People outside your academic community	32.1	67.9

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

0 times	0.0%
1 through 25 times	37.5%
26 through 50 times	29.2%
51 through 75 times	0.0%
More than 75 times	33.3%

India

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs?

Very Ineffective							Very Effective	
1	2	3	4	5	6	7		
%	%	%	%	%	%	%		
0.0	0.0	10.0	7.5	25.0	25.0	32.5		

21. As part of your academic preparation, have you received or participated in the following library activities?

	Yes 1 %	No 2 %	Not Available 6 %
Library tour	7.5	15.0	77.5
Library presentation as part of academic orientation	10.8	21.6	67.6
Library orientation as part of an engineering/science course	2.9	29.4	67.6
Library skill/use course (bibliographic instruction)	10.8	37.8	51.4
Library skill/use course in engineering/science information resources and materials	16.2	29.7	54.1
Library instruction for end-user searching of electronic (bibliographic) data bases	8.8	35.3	55.9

22. Which one of the following best characterizes your use of electronic data bases?

I do all searches myself	10.3%
I do most searches myself	20.5%
I do half by myself and half through a librarian	10.3%
I do most searches through a librarian	5.1%
I do all searches through a librarian	15.4%
I do not use electronic data bases	28.2%
I do not have access to electronic data bases	10.3%

India

These questions ask about the use and importance of information to engineering/science students.

23. How often during this current school term have you used the following information sources to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Your personal collection of information	0.0	2.5	10.0	60.0	27.5	0.0
Other students	0.0	12.5	77.5	7.5	2.5	0.0
Faculty members	2.6	15.4	38.5	33.3	10.3	0.0
Library	2.5	0.0	10.0	50.0	37.5	0.0
Librarian	64.1	20.5	10.3	0.0	0.0	5.1
Your personal contacts within industry	35.0	17.5	32.5	2.5	0.0	12.5
Your personal contacts at government laboratories	30.0	25.0	35.0	5.0	0.0	5.0

24. How often during this current school term have you used the following information products to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Abstracts	7.5	15.0	37.5	27.5	12.5	0.0
Conference/meeting papers	2.5	7.5	52.5	27.5	10.0	0.0
Journal articles	0.0	0.0	15.0	45.0	40.0	0.0
Handbooks	5.1	20.5	53.8	17.9	2.6	0.0
Textbooks	0.0	5.0	15.0	50.0	30.0	0.0
Computer programs & documentation	10.0	25.0	40.0	17.5	5.0	2.5
Bibliographic, numeric, factual data bases	32.5	30.0	27.5	7.5	0.0	2.5
Theses/dissertations	10.0	25.0	37.5	25.0	2.5	0.0
Technical reports	0.0	17.5	47.5	27.5	7.5	0.0
Audio/visual materials	46.2	30.8	20.5	0.0	0.0	2.6
Foreign language technical reports	82.5	10.0	5.0	0.0	0.0	2.5
Technical translations	57.5	35.0	7.5	0.0	0.0	0.0
Patents	83.8	8.1	8.1	0.0	0.0	0.0
Industry technical reports	35.9	28.2	30.8	2.6	2.6	0.0
Drawings/specifications	55.3	31.6	10.5	2.6	0.0	0.0
Preprints or deposited manuscripts	35.0	32.5	25.0	5.0	2.5	0.0
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	35.0	30.0	27.5	5.0	2.5	0.0

India

25. How important are the following information sources in meeting your engineering/science information needs?

	Very Unimportant						Very Important	Not Available
	1	2	3	4	5	6	7	8
	%	%	%	%	%	%	%	%
Your personal collection of information	0.0	5.0	2.5	2.5	10.0	10.0	70.0	0.0
Other students	5.0	5.0	20.0	32.5	25.0	10.0	2.5	0.0
Faculty members	0.0	5.0	7.5	22.5	20.0	35.0	10.0	0.0
Library	0.0	0.0	0.0	5.0	17.5	30.0	47.5	0.0
Librarian	35.9	25.6	23.1	7.7	0.0	2.6	0.0	5.1
Your personal contacts within industry	30.0	10.0	17.5	10.0	10.0	10.0	2.5	10.0
Your personal contacts at government laboratories	27.5	5.0	15.0	27.5	15.0	5.0	5.0	0.0

26. How important are the following information products in meeting your engineering/science information needs?

	Very Unimportant						Very Important	Not Available
	1	2	3	4	5	6	7	8
	%	%	%	%	%	%	%	%
Abstracts	5.0	5.0	15.0	22.5	20.0	12.5	20.0	0.0
Conference/meeting papers	0.0	5.0	5.0	22.5	25.0	22.5	20.0	0.0
Journal articles	0.0	0.0	2.5	5.0	7.5	22.5	62.5	0.0
Handbooks	7.5	7.5	17.5	15.0	32.5	12.5	7.5	0.0
Textbooks	0.0	7.5	5.0	10.0	15.0	17.5	45.0	0.0
Computer programs and documentation	7.5	10.0	30.0	7.5	22.5	12.5	10.0	0.0
Bibliographic, numeric, factual data bases	17.5	2.5	30.0	17.5	12.5	10.0	5.0	5.0
Theses/dissertations	5.0	7.5	17.5	17.5	27.5	15.0	10.0	0.0
Technical reports	2.6	7.7	10.3	12.8	28.2	15.4	23.1	0.0
Audio/visual materials	23.1	30.8	10.3	12.8	10.3	5.1	5.1	2.6
Foreign language technical reports	42.5	25.0	10.0	7.5	2.5	0.0	5.0	7.5
Technical translations	37.5	22.5	15.0	10.0	5.0	5.0	5.0	0.0
Patents	47.5	20.0	12.5	2.5	2.5	5.0	5.0	5.0
Industry technical reports	23.1	15.4	20.5	12.8	12.8	7.7	7.7	0.0
Drawings/specifications	35.0	12.5	25.0	10.0	5.0	7.5	2.5	2.5
Preprints or deposited manuscripts	27.5	15.0	20.0	10.0	15.0	7.5	5.0	0.0
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	27.5	20.0	17.5	7.5	12.5	5.0	10.0	0.0

India

27. Do you use the following technical reports in meeting your engineering/science information needs?

	Yes 1 %	No 2 %	Don't Have Access 3 %
AGARD reports	55.0	30.0	15.0
British ARC and RAE reports	48.7	33.3	17.9
Dutch NLR reports	7.9	55.3	36.8
ESA reports	8.1	54.1	37.8
Indian NAL reports	74.4	25.6	0.0
French ONERA reports	28.9	42.1	28.9
German DFVLR, DLR, and MBB reports	15.8	50.0	34.2
Japanese NAL reports	7.9	50.0	42.1
Russian TsAGI reports	2.6	47.4	50.0
U.S. NASA reports	90.0	10.0	0.0

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment?

	Step 1 %	2 %	3 %	4 %	5 %	6 %	Did Not Use 0 %
Used my personal store of technical information	35.9	7.7	20.5	23.1	7.7	0.0	5.1
Spoke with other students	0.0	17.9	15.4	28.2	28.2	0.0	10.3
Spoke with faculty members	28.2	23.1	25.6	17.9	2.6	0.0	2.6
Used literature resources	20.0	37.5	22.5	7.5	10.0	0.0	2.5
Spoke with a librarian	0.0	0.0	0.0	0.0	2.7	8.1	89.2
Used literature resources found in a library	17.5	17.5	15.0	17.5	30.0	0.0	2.5

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender?

Female	0.0%
Male	100.0%

30. What is your area of study/major?

Engineer	72.5%
Scientist	20.0%
Other	7.5%

31. What is your educational status?

Undergraduate student	0.0%
Master's student	40.0%
Doctoral student	60.0%

India

32. What is your native language?

Hindi	10.0%
Malayalam	7.5%
Tamil	45.0%
Telugu	12.5%
Other	25.0%

33. What is your native country?

India	100.0%
-------	--------

34. Are you a citizen of the country where you are attending school?

Yes	100.0%
-----	--------

35. How well do you read the following languages?

	Passably					Fluently	Do not read this language
	1	2	3	4	5	6	
	%	%	%	%	%	%	
English	0.0	2.5	0.0	7.5	90.0	0.0	
French	5.4	0.0	2.7	0.0	0.0	91.9	
German	13.5	2.7	2.7	2.7	0.0	78.4	
Japanese	0.0	0.0	0.0	0.0	0.0	100.0	
Russian	0.0	6.3	0.0	3.1	0.0	90.6	
Other	0.0	14.3	0.0	14.3	71.4	0.0	

36. How well do you speak the following languages?

	Passably					Fluently	Do not speak this language
	1	2	3	4	5	6	
	%	%	%	%	%	%	
English	0.0	2.5	2.5	17.5	77.5	0.0	
French	5.4	2.7	0.0	0.0	0.0	91.9	
German	10.8	5.4	2.7	0.0	0.0	81.1	
Japanese	0.0	0.0	0.0	0.0	0.0	100.0	
Russian	2.9	2.9	0.0	0.0	0.0	94.3	
Other	0.0	0.0	0.0	0.0	100.0	0.0	

India

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual?

Very Unimportant						Very Important	Am Not Bilingual	Don't Know
1	2	3	4	5	6	7	8	9
%	%	%	%	%	%	%	%	%
7.7	5.1	10.3	10.3	12.8	7.7	30.8	10.3	5.1

38. In what type of organization do you hope to work after graduation?

Academic	52.5%
Government	27.5%
Industry (national)	5.0%
Industry (multi-national)	10.0%
Not for profit	0.0%
Other	5.0%

39. When you were growing up, do you think your family's income was:

Much more than most families in your native country	0.0%
More than most families in your native country	27.5%
About equal to the average family incomes in your native country	65.0%
Lower than most families in your native country	5.0%
Much less than most families in your native country	0.0%
I cannot compare my family's income with other families	2.5%

40. Do you own a personal computer?

Yes	2.5%
No	97.5%

41. As a high school student, how often did you use your:

	Never	Seldom	Sometimes	Frequently	Always	Not Available
	1	2	3	4	5	6
	%	%	%	%	%	%
High school library	5.1	10.3	33.3	23.1	2.6	25.6
Public library	5.0	15.0	40.0	25.0	0.0	15.0

42. As an aerospace engineering/science major, about how many hours a week (exclusive of classroom and course assignments) do you spend reading the professional literature associated with your discipline?

0 hours	0.0%
1 through 5 hours	30.7%
6 through 10 hours	38.5%
11 through 25 hours	23.1%
More than 25 hours	7.8%

JAPAN

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Have the opportunity to explore new ideas about technology or systems	0.0	1.3	2.6	2.6	13.2	19.7	60.5
Advance to a high-level staff technical position	0.0	2.7	9.5	14.9	27.0	23.0	23.0
Have the opportunity to work on complex technical problems	1.3	0.0	1.3	11.8	21.1	32.9	31.6
Work on projects that utilize the latest theoretical results in your specialty	0.0	0.0	2.6	11.8	17.1	31.6	36.8
Work on projects that require learning new technical knowledge	1.3	0.0	2.6	7.8	19.5	23.4	45.5
Establish a reputation outside your organization as an authority in your field	6.8	5.5	8.2	24.7	30.1	12.3	12.3
Receive patents for your ideas	12.2	8.1	17.6	27.0	12.2	8.1	14.9
Publish articles in technical journals	8.1	2.7	9.5	28.4	25.7	16.2	9.5
Communicate your ideas to others in your profession through papers delivered at professional society meetings	3.9	3.9	5.3	15.8	23.7	25.0	22.4
Be evaluated on the basis of your technical contributions	1.3	2.6	10.4	14.3	31.2	16.9	23.4
Become a manager or director in your line of work	7.5	4.5	14.9	29.9	19.4	16.4	7.5
Plan and coordinate the work of others	17.8	6.8	20.5	31.5	12.3	9.6	1.4
Advance to a policy-making position in management	18.9	6.8	14.9	27.0	13.5	14.9	4.1
Plan projects and make decisions affecting the organization	8.3	1.4	9.7	27.8	19.4	27.8	5.6
Be the technical leader of a group of less experienced professionals	11.3	8.5	19.7	21.1	18.3	16.9	4.2

JAPAN

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	NA 8 %
Your parents encouraged your area of study/major	36.4	19.5	9.1	7.8	7.8	1.3	2.6	15.6
Other family members encouraged your area of study/major	40.3	24.7	2.6	3.9	2.6	1.3	1.3	23.4
Teachers encouraged your area of study/major	37.7	16.9	7.8	6.5	3.9	1.3	0.0	26.0
You feel that a career in your major/area of study will lead to financial security	22.1	5.2	18.2	26.0	14.3	2.6	5.2	6.5
You feel that a career in your major/area of study will provide a career with many rewarding activities	2.6	0.0	2.6	10.4	6.5	26.0	50.6	1.3
Information on the career opportunities available in your major/area of study	10.4	5.2	13.0	22.1	18.2	7.8	16.9	6.5

3. When did you first decide on your area of study/major?

In elementary school	10.4%
Junior high school	15.6%
Senior high school	40.3%
Before the entrance of college	9.1%
Right after the entrance of college	6.5%
After the entrance of college	18.2%

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path?

I am more happy about my career choice now than when I first made it	13.0%
I feel about the same now as when I first made it	62.3%
I am less happy about my career choice now than when I first made it	24.7%

JAPAN

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Effectively communicate technical information in writing	0.0	0.0	2.6	6.6	23.7	21.1	46.1
Effectively communicate technical information orally	0.0	2.6	2.6	5.3	22.4	22.4	44.7
Have a knowledge and understanding of engineering/science information resources and materials	0.0	0.0	0.0	2.6	19.5	24.7	53.2
Be able to search electronic (bibliographic) data bases	0.0	4.2	9.7	13.9	25.0	25.0	22.2
Know how to use a library that contains engineering/science information resources and materials	0.0	0.0	5.3	20.0	26.7	17.3	30.7
Effectively use computer, communication, and information technology	0.0	2.6	1.3	15.8	9.2	26.3	44.7

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in:

	Yes 1 %	No 2 %	No Instruction Available 8 %
Technical writing/communication	10.5	73.7	15.8
Speech/oral communication	13.2	71.1	15.8
Using a library that contains engineering/science information resources and materials	10.5	73.7	15.8
Using engineering/science information resources and materials	9.3	76.0	14.7
Searching electronic (bibliographic) data bases	11.7	74.0	14.3
Using computer, communication, and information technology	43.4	44.7	11.8

JAPAN

7. If you received training or instruction in any of the following, was it helpful?

	Not Helpful	1	2	3	4	5	6	Very Helpful	No Training
		1	2	3	4	5	6	7	10
		%	%	%	%	%	%	%	%
Technical writing/communication	0.0	1.3	0.0	1.3	2.7	1.3	4.0	89.3	
Speech/oral communication	0.0	0.0	2.7	4.0	2.7	2.7	2.7	85.3	
Using a library that contains engineering/science information resources and materials	0.0	0.0	1.3	2.7	2.7	1.3	2.7	89.3	
Using engineering/science information resources and materials	0.0	0.0	2.7	2.7	2.7	0.0	4.0	88.0	
Searching electronic (bibliographic) data bases	1.3	0.0	2.6	2.6	5.3	0.0	1.3	86.8	
Using computer, communication, and information technology	1.4	1.4	5.5	2.7	13.7	6.8	9.6	58.9	

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. What percentage of your written technical communication involves collaborative writing?

0 percent	63.2%
1 through 25 percent	14.7%
26 through 50 percent	7.4%
51 through 75 percent	1.5%
76 through 99 percent	2.9%
100 percent	10.3%

9. If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?

0 percent	0.0%
1 through 25 percent	18.2%
26 through 50 percent	68.2%
51 through 75 percent	9.1%
76 through 99 percent	4.6%
100 percent	0.0%

10. In general, do you find writing as part of a group more or less productive than writing alone?

Less productive than writing alone	24.1%
About as productive as writing alone	34.5%
More productive than writing alone	41.4%

11. Do you use a computer to prepare written technical communication?

Never	9.3%
Sometimes	30.7%
Frequently	30.7%
Always	29.3%

12. Which of the following best explains your reasons for non-use?

No or limited computer access	28.6%
Lack of knowledge/skill using a computer	28.6%
Prefer not to use a computer	0.0%
No need to use	42.9%
Other	0.0%

JAPAN

13. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce written technical communication?

	Does not Impede 1 %	2 %	3 %	4 %	5 %	6 %	Greatly Impedes 7 %
Defining the purpose of the communication	4.2	6.9	5.6	9.7	23.6	18.1	31.9
Assessing the needs of the reader	5.9	5.9	22.1	14.7	29.4	14.7	7.4
Preparing/presenting information in an organized manner	1.4	2.8	2.8	9.7	25.0	37.5	20.8
Developing paragraphs (introductions, transitions, and conclusions)	2.7	5.4	5.4	12.2	41.9	24.3	8.1
Writing grammatically correct sentences	2.7	5.3	17.3	14.7	37.3	16.0	6.7
Notetaking and quoting	1.4	2.9	11.6	29.0	31.9	18.8	4.3
Editing and revising	1.4	5.6	2.8	26.4	37.5	19.4	6.9

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information.

	I already use it 1 %	I don't use it, but may in the future 2 %	I don't use it and doubt if I will 3 %
Audio tapes and cassettes	9.5	25.7	64.9
Motion picture film	2.7	20.0	77.3
Video tape	21.3	72.0	6.7
Desktop/electronic publishing	13.9	62.5	23.6
Computer cassette/cartridge tapes	31.5	35.6	32.9
Electronic mail	26.7	64.0	9.3
Electronic bulletin boards	20.0	62.7	17.3
FAX or TELEX	21.3	73.3	5.3
Electronic data bases	6.8	86.3	6.8
Video conferencing	0.0	66.2	33.8
Computer conferencing	0.0	70.3	29.7
Micrographics & microforms	5.3	60.0	34.7

JAPAN

15. Do you ever use electronic networks?

Yes, I personally use them	36.0%
Yes, I use them but through an intermediary	5.3%
No	18.7%
No, because I do not have access	2.7%
No, but I may use them in the future	37.3%

16. Do you use electronic networks for the following purposes?

	Yes 1 %	No 2 %
To connect to geographically distant sites	45.2	54.8
For electronic mail	67.7	32.3
For electronic bulletin boards or conferences	51.6	48.4
For electronic file transfer	64.5	35.5
To log into computers for such things as computational analysis or to use design tools	71.0	29.0
To control equipment such as laboratory instruments or machine tools	3.2	96.8
To access/search the library's catalogue	45.2	54.8
To order documents from the library	9.7	90.3
To search electronic (bibliographic) data bases	25.8	74.2
For information search and data retrieval	45.2	54.8
To prepare scientific and technical papers with colleagues at geographically distant sites	3.2	96.8

17. Do you exchange electronic messages or files with:

	Yes 1 %	No 2 %
Members of your academic classes	51.6	48.4
Other people in your academic community at the same geographic site who are not in your academic classes	61.3	38.7
Other people in your academic community at a different geographic site who are not in your academic classes	35.5	64.5
People outside your academic community	48.4	51.6

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

0 times	5.4%
1 through 25 times	86.7%
26 through 50 times	8.2%
51 through 75 times	0.0%
More than 75 times	0.0%

JAPAN

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs?

Very Ineffective				Very Effective			
1	2	3	4	5	6	7	
%	%	%	%	%	%	%	
4.2	2.8	1.4	12.5	36.1	26.4	16.7	

20. Which of the following statements best describes your reasons for not using a library during this current school term?

	Yes 1 %	No 2 %
I had no information needs	100.0	0.0
My information needs were more easily met some other way	0.0	100.0
Tried the library once or twice before but I couldn't find the information I needed	0.0	100.0
The library is physically too far away	0.0	100.0
The library staff is not cooperative or helpful	0.0	100.0
The library staff does not understand my information needs	0.0	100.0
The library did not have the information I need	0.0	100.0
I have my own personal library and do not need another library	25.0	75.0
The library is too slow in getting the information I need	0.0	100.0
We have to pay to use the library	0.0	100.0
We are discouraged from using the library	0.0	100.0

21. As part of your academic preparation, have you received or participated in the following library activities?

	Yes 1 %	No 2 %	Not Available 6 %
Library tour	8.3	79.2	12.5
Library presentation as part of academic orientation	17.8	72.6	9.6
Library orientation as part of an engineering/science course	15.3	72.2	12.5
Library skill/use course (bibliographic instruction)	2.7	83.6	13.7
Library skill/use course in engineering/science information resources and materials	2.7	84.9	12.3
Library instruction for end-user searching of electronic (bibliographic) data bases	8.2	79.5	12.3

22. Which one of the following best characterizes your use of electronic data bases?

I do all searches myself	11.7%
I do most searches myself	20.8%
I do half by myself and half through a librarian	11.7%
I do most searches through a librarian	3.9%
I do all searches through a librarian	3.9%
I do not use electronic data bases	31.2%
I do not have access to electronic data bases	16.9%

JAPAN

These questions ask about the use and importance of information to engineering/science students.

23. How often during this current school term have you used the following information sources to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Your personal collection of information	3.9	7.8	15.6	40.3	31.2	1.3
Other students	10.4	27.3	31.2	27.3	3.9	0.0
Faculty members	6.5	20.8	42.9	23.4	5.2	1.3
Library	5.2	14.3	24.7	42.9	13.0	0.0
Librarian	55.8	27.3	11.7	5.2	0.0	0.0
Your personal contacts within industry	55.8	18.2	9.1	0.0	0.0	16.9
Your personal contacts at government laboratories	51.9	10.4	13.0	5.2	2.6	16.9

24. How often during this current school term have you used the following information products to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Abstracts	27.3	27.3	22.1	18.2	5.2	0.0
Conference/meeting papers	22.1	18.2	20.8	31.2	7.8	0.0
Journal articles	30.3	19.7	28.9	17.1	3.9	0.0
Handbooks	27.3	29.9	31.2	10.4	1.3	0.0
Textbooks	5.2	7.8	22.1	49.4	15.6	0.0
Computer programs & documentation	26.0	31.2	23.4	16.9	2.6	0.0
Bibliographic, numeric, factual data bases	55.8	26.0	6.5	9.1	2.6	0.0
Theses/dissertations	29.9	22.1	18.2	24.7	5.2	0.0
Technical reports	40.3	20.8	22.1	13.0	2.6	1.3
Audio/visual materials	83.1	9.1	2.6	1.3	0.0	3.9
Foreign language technical reports	41.6	18.2	16.9	18.2	5.2	0.0
Technical translations	44.2	23.4	22.1	10.4	0.0	0.0
Patents	92.2	2.6	2.6	0.0	0.0	2.6
Industry technical reports	68.4	19.7	6.6	0.0	0.0	5.3
Drawings/specifications	74.0	10.4	10.4	1.3	0.0	3.9
Preprints or deposited manuscripts	75.3	9.1	6.5	1.3	0.0	7.8
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	63.6	19.5	11.7	0.0	0.0	5.2

JAPAN

25. How important are the following information sources in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Your personal collection of information	2.6	9.1	2.6	15.6	18.2	15.6	35.1	1.3
Other students	3.9	16.9	13.0	18.2	24.7	14.3	9.1	0.0
Faculty members	2.6	3.9	9.1	6.5	22.1	22.1	33.8	0.0
Library	5.2	5.2	5.2	14.3	15.6	19.5	35.1	0.0
Librarian	42.9	20.8	14.3	7.8	5.2	5.2	2.6	1.3
Your personal contacts within industry	33.8	14.3	3.9	5.2	2.6	9.1	3.9	27.3
Your personal contacts at government laboratories	32.5	10.4	2.6	5.2	6.5	9.1	7.8	26.0

26. How important are the following information products in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Abstracts	24.0	6.7	8.0	16.0	14.7	10.7	18.7	1.3
Conference/meeting papers	14.7	8.0	6.7	16.0	13.3	18.7	22.7	0.0
Journal articles	17.3	16.0	6.7	13.3	17.3	14.7	14.7	0.0
Handbooks	22.7	13.3	12.0	26.7	8.0	13.3	4.0	0.0
Textbooks	5.3	5.3	12.0	13.3	20.0	13.0	30.7	0.0
Computer programs and documentation	21.3	21.3	10.7	21.3	8.0	6.7	10.7	0.0
Bibliographic, numeric, factual data bases	37.3	12.0	17.3	14.7	5.3	6.7	4.0	2.7
Theses/dissertations	16.0	9.3	10.7	13.3	14.7	18.7	16.0	1.3
Technical reports	34.7	8.0	6.7	16.0	14.7	6.7	12.0	1.3
Audio/visual materials	60.0	9.3	8.0	6.7	4.0	1.3	1.3	9.3
Foreign language technical reports	33.3	10.7	6.7	9.3	13.3	12.0	14.7	0.0
Technical translations	37.3	13.3	2.7	17.3	9.3	8.0	10.7	1.3
Patents	72.0	5.3	5.3	8.0	1.3	0.0	1.3	6.7
Industry technical reports	53.3	6.7	6.7	12.0	8.0	4.0	1.3	8.0
Drawings/specifications	52.0	14.7	8.0	9.3	5.3	2.7	0.0	8.0
Preprints or deposited manuscripts	56.0	4.0	8.0	13.3	1.3	0.0	4.0	13.3
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	48.0	10.7	9.3	14.7	2.7	1.3	1.3	12.0

JAPAN

27. Do you use the following technical reports in meeting your engineering/science information needs?

	Yes	No	Don't Have Access
	1	2	6
	%	%	%
AGARD reports	16.9	76.6	6.5
British ARC and RAE reports	11.7	81.8	6.5
Dutch NLR reports	2.6	87.0	10.4
ESA reports	11.7	80.5	7.8
Indian NAL reports	0.0	88.3	11.7
French ONERA reports	6.5	83.1	10.4
German DFVLR, DLR, and MBB reports	5.2	84.4	10.4
Japanese NAL reports	53.2	42.9	3.9
Russian TsAGI reports	1.3	87.0	11.7
U.S. NASA reports	64.9	32.5	2.6

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment?

	Step 1	2	3	4	5	6	Step 7	Did Not Use
	%	%	%	%	%	%	%	0
	%	%	%	%	%	%	%	%
Used my personal store of technical information	63.6	15.2	7.6	7.6	3.0	0.0	0.0	3.0
Spoke with other students	4.6	26.2	21.5	13.8	16.9	3.1	0.0	13.8
Spoke with faculty members	12.1	15.2	18.2	15.2	15.2	1.5	1.5	21.2
Used literature resources	15.2	22.7	13.6	19.7	4.5	0.0	0.0	24.2
Spoke with a librarian	0.0	1.5	0.0	0.0	4.4	4.4	0.0	89.7
Used literature resources found in a library	1.5	18.2	36.4	18.2	6.1	0.0	0.0	19.7
Searched an electronic database at the library	2.9	1.5	1.5	1.5	1.5	7.4	1.5	82.4
Used none of the above	13.0	0.0	0.0	0.0	0.0	0.0	0.0	87.0

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender?

Female	4.1%
Male	95.9%

30. What is your educational status?

Undergraduate	54.1%
Graduate	37.8%
Other	8.1%

31. Is your education primarily as:

Engineer	97.3%
Scientist	2.7%
Other	0.0%

JAPAN

32. What is your native language?

Japanese 100%

33. What is your native country?

Japan 100%

34. Are you a citizen of the country where you are attending school?

Yes 93.2%

No 6.8%

35. How well do you read the following languages?

	Passably					Fluently	Do not read this language
	1	2	3	4	5	6	
	%	%	%	%	%	%	
English	9.5	8.1	43.2	36.5	2.7	0.0	
French	21.9	5.5	0.0	0.0	0.0	72.6	
German	45.2	13.7	1.4	1.4	1.4	37.0	
Japanese	0.0	0.0	2.7	4.1	90.5	2.7	
Russian	9.7	1.4	1.4	0.0	0.0	87.5	
Other	0.0	0.0	3.9	0.0	0.0	96.1	

36. How well do you speak the following languages?

	Passably					Fluently	Do not speak this language
	1	2	3	4	5	6	
	%	%	%	%	%	%	
English	28.0	25.3	29.3	9.3	2.7	5.3	
French	16.2	0.0	1.4	0.0	0.0	82.4	
German	27.0	2.7	0.0	1.4	1.4	67.6	
Japanese	0.0	0.0	2.7	9.3	85.3	2.7	
Russian	8.2	1.4	0.0	0.0	0.0	90.4	

JAPAN

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual?

Very Unimportant						Very Important		Am Not Bilingual	Don't Know
1	2	3	4	5	6	7	8	9	
%	%	%	%	%	%	%	%	%	%
0.0	1.3	2.7	2.7	2.7	14.7	40.0	36.0	0.0	

38. In what type of organization do you hope to work after graduation?

Academic	35.1%
Government	2.6%
Industry (national)	29.9%
Industry (multi-national)	19.5%
Not for profit	5.2%
Other	5.2%

39. When you were growing up, do you think your family's income was:

Much more than most families in your native country	0.0%
More than most families in your native country	22.7%
About equal to the average family incomes in your native country	62.7%
Lower than most families in your native country	9.3%
Much less than most families in your native country	2.7%
I cannot compare my family's income with other families	2.7%

40. Do you own a personal computer?

Yes	77.3%
No	22.7%

41. As a high school student, how often did you use your:

	Never	Seldom	Sometimes	Frequently	Always	Not Available
	1	2	3	4	5	6
	%	%	%	%	%	%
High school library	22.7	22.7	29.3	21.3	4.0	0.0
Public library	40.5	36.5	8.1	10.8	4.1	0.0

42. About how many hours a week do you spend reading technical literature (other than textbooks and homework assignments) for the purpose of self-education?

0 hours	12.2%
1 through 5 hours	52.8%
6 through 10 hours	27.1%
11 through 25 hours	8.2%
More than 25 hours	0.0%

43. Are you a member of a professional student (national) engineering, scientific, or technical society?

Yes	28.8%
No	71.2%

RUSSIA

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Have the opportunity to explore new ideas about technology or systems	2.6	0.9	2.6	10.4	17.4	12.2	53.9
Advance to a high-level staff technical position	15.9	8.8	11.5	15.0	13.3	14.2	21.2
Have the opportunity to work on complex technical problems	3.7	2.8	8.3	14.8	20.4	21.3	28.7
Work on projects that utilize the latest theoretical results in your specialty	1.8	4.5	6.3	9.0	19.8	25.2	33.3
Work on projects that require learning new technical knowledge	3.6	6.3	8.9	13.4	12.5	20.5	34.8
Establish a reputation outside your organization as an authority in your field	4.3	6.1	5.2	9.6	15.7	25.2	33.9
Receive patents for your ideas	8.3	4.6	6.4	10.1	12.8	22.0	35.8
Publish articles in technical journals	16.1	4.5	16.1	12.5	19.6	9.8	21.4
Communicate your ideas to others in your profession through papers delivered at professional society meetings	7.9	4.4	5.3	21.1	15.8	20.2	25.4
Be evaluated on the basis of your technical contributions	8.2	10.0	9.1	16.4	18.2	14.5	23.6
Become a manager or director in your line of work	18.3	7.3	6.4	11.9	22.0	18.3	15.6
Plan and coordinate the work of others	14.3	12.5	11.6	18.8	17.0	12.5	13.4
Advance to a policy-making position in management	21.1	10.1	10.1	14.7	12.8	11.0	20.2
Plan projects and make decisions affecting the organization	6.3	8.1	17.1	16.2	11.7	20.7	19.8
Be the technical leader of a group of less experienced professionals	11.3	14.2	16.0	14.2	18.9	13.2	12.3

RUSSIA

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	NA 8 %
Your parents encouraged your area of study/major	21.4	7.7	9.4	15.4	14.5	8.5	10.3	12.8
Other family members encouraged your area of study/major	44.4	8.5	6.0	6.0	6.0	2.6	4.3	22.2
Teachers encouraged your area of study/major	39.7	9.5	9.5	10.3	5.2	2.6	8.6	14.7
You feel that a career in your major/area of study will lead to financial security	26.5	13.7	12.0	12.8	7.7	6.8	7.7	12.8
You feel that a career in your major/area of study will provide a career with many rewarding activities	21.4	16.2	16.2	13.7	8.5	6.8	4.3	12.8
Information on the career opportunities available in your major/area of study	7.7	6.0	4.3	17.1	12.0	17.1	21.4	14.5

3. When did you first decide on your area of study/major?

While still in elementary school	11.2%
While in high school (or equivalent)	47.4%
When you started college (or equivalent)	17.2%
After starting college (or equivalent)	19.0%
Other	5.2%

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path?

I am more happy about my career choice now than when I first made it	25.2%
I feel about the same now as when I first made it	36.5%
I am less happy about my career choice now than when I first made it	38.3%

RUSSIA

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Effectively communicate technical information in writing	5.3	5.3	7.9	15.8	17.5	9.6	38.6
Effectively communicate technical information orally	3.6	5.4	5.4	16.1	16.1	16.1	37.5
Have a knowledge and understanding of engineering/science information resources and materials	2.7	0.0	1.8	10.9	13.6	15.5	55.5
Be able to search electronic (bibliographic) data bases	2.8	4.6	1.8	4.6	12.8	22.9	50.5
Know how to use a library that contains engineering/science information resources and materials	4.5	2.7	3.6	8.1	16.2	19.8	45.0
Effectively use computer, communication, and information technology	0.0	2.7	0.0	3.6	8.1	19.8	65.8

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in:

	Yes 1 %	No 2 %	No Instruction Available 8 %
Technical writing/communication	41.1	25.9	33.0
Speech/oral communication	43.8	26.8	29.5
Using a library that contains engineering/science information resources and materials	53.6	25.9	20.5
Using engineering/science information resources and materials	59.5	20.7	19.8
Searching electronic (bibliographic) data bases	17.1	30.6	52.3
Using computer, communication, and information technology	32.4	27.0	40.5

RUSSIA

7. If you received training or instruction in any of the following, was it helpful?

	Not Helpful 1	2	3	4	5	6	Very Helpful 7	No Training 10
	%	%	%	%	%	%	%	%
Technical writing/communication	2.9	0.0	0.0	13.7	11.8	3.9	13.7	53.9
Speech/oral communication	1.0	2.0	6.1	10.1	8.1	8.1	12.1	52.5
Using a library that contains engineering/science information resources and materials	2.0	1.0	4.0	8.9	8.9	10.9	28.7	35.6
Using engineering/science information resources and materials	1.0	1.0	5.1	8.2	9.2	13.3	29.6	32.7
Searching electronic (bibliographic) data bases	2.0	4.0	2.0	2.0	4.0	5.0	8.9	72.3
Using computer, communication, and information technology	1.9	1.0	4.8	2.9	4.8	2.9	21.9	60.0

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. What percentage of your written technical communication involves collaborative writing?

0 percent	33.0%
1 through 25 percent	18.1%
26 through 50 percent	23.8%
51 through 75 percent	10.1%
76 through 99 percent	10.1%
100 percent	4.5%

9. If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?

0 percent	3.6%
1 through 25 percent	23.4%
26 through 50 percent	53.6%
51 through 75 percent	7.2%
76 through 99 percent	5.4%
100 percent	7.1%

10. In general, do you find writing as part of a group more or less productive than writing alone?

Less productive than writing alone	6.5%
About as productive as writing alone	22.6%
More productive than writing alone	71.0%

11. Do you use a computer to prepare written technical communication?

Never	29.7%
Sometimes	43.6%
Frequently	17.8%
Always	8.9%

12. Which of the following best explains your reasons for non-use?

No or limited computer access	73.3%
Lack of knowledge/skill using a computer	26.7%
Prefer not to use a computer	6.7%
Other	13.3%

RUSSIA

13. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce written technical communication?

	Does not Impede 1 %	2 %	3 %	4 %	5 %	6 %	Greatly Impedes 7 %
Defining the purpose of the communication	15.8	2.1	5.3	7.4	11.6	14.7	43.2
Assessing the needs of the reader	15.0	11.3	10.0	13.8	16.3	18.8	15.0
Preparing/presenting information in an organized manner	11.7	4.3	7.4	9.6	12.8	23.4	30.9
Developing paragraphs (introductions, transitions, and conclusions)	22.7	9.3	13.4	9.3	10.3	16.5	18.6
Writing grammatically correct sentences	24.5	6.4	11.7	9.6	14.9	13.8	19.1
Notetaking and quoting	23.7	8.6	17.2	14.0	12.9	15.1	8.6
Editing and revising	14.4	8.9	10.0	11.1	12.2	15.6	27.8

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information.

	I already use it 1 %	I don't use it, but may in the future 2 %	I don't use it and doubt if I will 3 %
Audio tapes and cassettes	25.2	27.2	47.6
Motion picture film	19.6	36.3	44.1
Video tape	20.4	58.3	21.4
Desktop/electronic publishing	17.1	62.9	20.0
Computer cassette/cartridge tapes	45.2	46.2	8.7
Electronic mail	4.8	72.1	23.1
Electronic bulletin boards	4.8	66.3	28.8
FAX or TELEX	10.6	68.3	21.2
Electronic data bases	17.6	65.7	16.7
Video conferencing	2.9	56.7	40.4
Computer conferencing	1.0	63.5	35.6
Micrographics & microforms	13.5	49.0	37.5

RUSSIA

15. Do you ever use electronic networks?

Yes, I personally use them	2.8%
Yes, I use them but through an intermediary	17.9%
No	8.5%
No, because I do not have access	37.7%
No, but I may use them in the future	33.0%

16. Do you use electronic networks for the following purposes?

	Yes 1 %	No 2 %
To connect to geographically distant sites	15.8	84.2
For electronic mail	21.1	78.9
For electronic bulletin boards or conferences	5.3	94.7
For electronic file transfer	78.9	21.1
To log into computers for such things as computational analysis or to use design tools	80.0	20.0
To control equipment such as laboratory instruments or machine tools	35.0	65.0
To access/search the library's catalogue	47.4	52.6
To order documents from the library	26.3	73.7
To search electronic (bibliographic) data bases	26.3	73.7
For information search and data retrieval	50.0	50.0
To prepare scientific and technical papers with colleagues at geographically distant sites	15.8	84.2

17. Do you exchange electronic messages or files with:

	Yes 1 %	No 2 %
Members of your academic classes	36.8	63.2
Other people in your academic community at the same geographic site who are not in your academic classes	26.3	73.7
Other people in your academic community at a different geographic site who are not in your academic classes	15.8	84.2
People outside your academic community	5.0	95.0

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

0 times	24.5%
1 through 25 times	70.4%
26 through 50 times	2.8%
51 through 75 times	0.0%
More than 75 times	1.9%

RUSSIA

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs?

Very Ineffective				Very Effective			
1	2	3	4	5	6	7	
%	%	%	%	%	%	%	
8.9	2.5	3.8	7.6	29.1	15.2	32.9	

20. Which of the following statements best describes your reasons for not using a library during this current school term?

	Yes	No
	1	2
	%	%
I had no information needs	65.2	34.8
My information needs were more easily met some other way	78.3	21.7
Tried the library once or twice before but I couldn't find the information I needed	54.5	45.5
The library is physically too far away	15.8	84.2
The library staff is not cooperative or helpful	54.5	45.5
The library staff does not understand my information needs	60.0	40.0
The library did not have the information I need	72.7	27.3
I have my own personal library and do not need another library	63.6	36.4
The library is too slow in getting the information I need	31.6	68.4
We have to pay to use the library	0.0	100.0
We are discouraged from using the library	60.0	40.0

21. As part of your academic preparation, have you received or participated in the following library activities?

	Yes	No	Not Available
	1	2	6
	%	%	%
Library tour	13.0	60.9	26.1
Library presentation as part of academic orientation	28.7	50.0	21.3
Library orientation as part of an engineering/science course	17.2	58.6	24.1
Library skill/use course (bibliographic instruction)	19.1	56.2	24.7
Library skill/use course in engineering/science information resources and materials	15.6	58.9	25.6
Library instruction for end-user searching of electronic (bibliographic) data bases	10.0	64.4	25.6

22. Which one of the following best characterizes your use of electronic data bases?

I do all searches myself	4.9%
I do most searches myself	4.9%
I do half by myself and half through a librarian	1.0%
I do most searches through a librarian	1.9%
I do all searches through a librarian	0.0%
I do not use electronic data bases	14.6%
I do not have access to electronic data bases	72.8%

RUSSIA

These questions ask about the use and importance of information to engineering/science students.

23. How often during this current school term have you used the following information sources to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Your personal collection of information	4.8	12.4	22.9	25.7	32.4	1.9
Other students	5.7	17.9	45.3	21.7	9.4	0.0
Faculty members	39.6	25.5	19.8	10.4	2.8	1.9
Library	15.1	25.5	21.7	17.0	20.8	0.0
Librarian	80.0	11.4	2.9	2.9	1.0	1.9
Your personal contacts within industry	37.7	13.2	17.0	13.2	10.4	8.5
Your personal contacts at government laboratories	39.6	12.3	11.3	12.3	13.2	11.3

24. How often during this current school term have you used the following information products to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Abstracts	67.3	6.7	14.4	3.8	0.0	7.7
Conference/meeting papers	66.7	7.6	8.6	4.8	1.0	11.4
Journal articles	30.2	25.5	20.8	16.0	5.7	1.9
Handbooks	3.7	9.3	23.4	35.5	27.1	0.9
Textbooks	5.6	2.8	15.0	24.3	51.4	0.9
Computer programs & documentation	43.4	11.3	11.3	10.4	15.1	8.5
Bibliographic, numeric, factual data bases	58.5	10.4	2.8	1.9	1.9	24.5
Theses/dissertations	58.5	14.2	7.5	2.8	2.8	14.2
Technical reports	49.5	10.5	16.2	5.7	3.8	14.3
Audio/visual materials	53.8	9.6	12.5	3.8	1.0	19.2
Foreign language technical reports	41.1	18.7	9.3	7.5	4.7	18.7
Technical translations	35.2	21.9	16.2	8.6	5.7	12.4
Patents	69.8	5.7	1.9	0.9	0.9	20.8
Industry technical reports	58.1	10.5	5.7	5.7	1.9	18.1
Drawings/specifications	37.4	17.8	13.1	15.0	7.5	9.3
Preprints or deposited manuscripts	53.8	10.6	5.8	2.9	0.0	26.9
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	39.3	19.6	15.9	11.2	6.5	7.5

RUSSIA

25. How important are the following information sources in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Your personal collection of information	7.5	8.4	11.2	13.1	13.1	9.3	34.6	2.8
Other students	6.6	8.5	13.2	19.8	21.7	17.9	10.4	1.9
Faculty members	17.8	15.9	9.3	10.3	12.1	12.1	15.9	6.5
Library	17.0	5.7	5.7	10.4	15.1	11.3	33.0	1.9
Librarian	54.7	17.0	6.6	4.7	1.9	3.8	1.9	9.4
Your personal contacts within industry	25.2	6.5	7.5	11.2	10.3	6.5	14.0	18.7
Your personal contacts at government laboratories	22.6	4.7	7.5	7.5	15.1	1.9	17.9	22.6

26. How important are the following information products in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Abstracts	40.8	13.6	11.7	5.8	6.8	2.9	4.9	13.6
Conference/meeting papers	35.6	13.5	9.6	9.6	5.8	2.9	7.7	15.4
Journal articles	12.5	7.7	10.6	11.5	16.3	18.3	21.2	1.9
Handbooks	2.9	1.9	4.8	13.5	16.3	16.3	43.3	1.0
Textbooks	4.9	1.9	7.8	7.8	10.7	19.4	47.6	0.0
Computer programs and documentation	15.4	12.5	5.8	12.5	7.7	11.5	20.2	14.4
Bibliographic, numeric, factual data bases	24.3	5.8	9.7	8.7	7.8	4.9	5.8	33.0
Theses/dissertations	25.7	7.9	13.9	12.9	9.9	7.9	5.0	16.8
Technical reports	25.0	2.9	9.6	9.6	13.5	9.6	12.5	17.3
Audio/visual materials	26.7	7.6	9.5	8.6	8.6	6.7	8.6	23.8
Foreign language technical reports	18.3	8.7	8.7	4.8	9.6	14.4	12.5	23.1
Technical translations	19.6	7.8	13.7	11.8	11.8	14.7	9.8	10.8
Patents	27.2	11.7	9.7	7.8	4.9	5.8	7.8	25.2
Industry technical reports	34.0	9.7	5.8	7.8	7.8	9.7	9.7	15.5
Drawings/specifications	29.8	5.8	6.7	6.7	14.4	12.5	13.5	10.6
Preprints or deposited manuscripts	31.7	4.0	5.9	11.9	6.9	3.0	4.0	32.7
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	28.8	15.4	11.5	10.6	13.5	3.8	9.6	6.7

RUSSIA

27. Do you use the following technical reports in meeting your engineering/science information needs?

	Yes 1 %	No 2 %	Don't Have Access 6 %
AGARD reports	2.0	20.8	77.2
British ARC and RAE reports	4.0	19.8	76.2
Dutch NLR reports	2.0	19.8	78.2
ESA reports	11.9	17.8	70.3
French ONERA reports	4.0	17.8	78.2
German DFVLR, DLR, and MBB reports	4.0	18.0	78.0
Japanese NAL reports	3.0	19.8	77.2
Russian TsAGI reports	47.1	29.8	23.1
U.S. NASA reports	21.6	16.7	61.8

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment?

	Step 1 %	2 %	3 %	4 %	5 %	6 %	Step 7 %	Did Not Use 0 %
Used my personal store of technical information	45.7	19.1	11.7	8.5	1.1	0.0	3.2	10.6
Spoke with other students	19.8	37.5	13.5	8.3	4.2	1.0	1.0	14.6
Spoke with faculty members	23.2	17.9	22.1	10.5	4.2	1.1	0.0	21.1
Used literature resources	2.1	10.5	14.7	17.9	2.1	3.2	1.1	48.4
Spoke with a librarian	0.0	2.3	0.0	2.3	1.1	1.1	0.0	93.1
Used literature resources found in a library	2.2	8.6	20.4	17.2	12.9	3.2	1.1	34.4
Searched an electronic database in the library	0.0	1.3	0.0	0.0	0.0	0.0	0.0	98.7
Used none of the above steps	0.0	---	---	---	---	---	---	100.0

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender?

Female	13.0%
Male	87.0%

30. What is your area of study/major?

Engineer	89.2%
Scientist	6.9%
Other	3.9%

RUSSIA

31. What course are you studying? (special classes)

Lower classes	39.0%
Advanced classes	61.0%

32. What is your native language?

Russian	100.0%
---------	--------

33. What is your native country?

Russia	100.0%
--------	--------

34. Are you a citizen of the country where you are attending school?

Yes	94.4%
No	5.6%

35. How well do you read the following languages?

	Passably					Fluently	Do not read this language
	1	2	3	4	5	6	
	%	%	%	%	%	%	
English	12.3	11.3	27.4	21.7	8.5	18.9	
French	12.9	3.0	4.0	2.0	2.0	76.2	
German	10.9	3.0	7.9	4.0	3.0	71.3	
Japanese	6.1	1.0	1.0	0.0	3.1	88.8	
Russian	1.9	0.0	0.0	0.0	93.3	4.8	
Other	0.9	0.0	0.0	0.0	0.0	99.1	

36. How well do you speak the following languages?

	Passably					Fluently	Do not speak this language
	1	2	3	4	5	6	
	%	%	%	%	%	%	
English	20.6	11.2	27.1	14.0	5.6	21.5	
French	11.8	5.9	2.9	1.0	2.0	76.5	
German	9.8	4.9	3.9	3.9	2.9	74.5	
Japanese	6.1	3.0	0.0	0.0	2.0	88.9	
Russian	1.9	0.0	0.0	0.9	91.5	5.7	
Other	0.9	0.0	0.0	0.0	0.0	99.1	

RUSSIA

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual?

Very Unimportant							Very Important	Am Not Bilingual	Don't Know
1	2	3	4	5	6	7	8	9	
%	%	%	%	%	%	%	%	%	%
1.9	0.0	1.9	5.8	7.7	17.3	48.1	12.5		4.8

38. In what type of organization do you hope to work after graduation?

Academic	8.5%
Government	23.9%
Industry (national)	17.9%
Industry (multi-national)	23.9%
Not for profit	2.6%
Other	16.2%

39. When you were growing up, do you think your family's income was:

Much more than most families in your native country	6.7%
More than most families in your native country	8.6%
About equal to the average family incomes in your native country	68.6%
Lower than most families in your native country	11.4%
Much less than most families in your native country	1.9%
I cannot compare my family's income with other families	2.9%

40. Do you own a personal computer?

Yes	11.4%
No	88.6%

41. As a high school student, how often did you use your:

	Never	Seldom	Sometimes	Frequently	Always	Not Available
	1	2	3	4	5	6
	%	%	%	%	%	%
High school library	8.9	17.8	31.7	21.8	17.8	2.0
Public library	17.3	23.1	27.9	21.2	7.7	2.9

42. As an aerospace engineering/science major, about how many hours a week (exclusive of classroom and course assignments) do you spend reading the professional literature associated with your discipline?

0 hours	7.2%
1 through 5 hours	38.1%
6 through 10 hours	25.8%
11 through 25 hours	16.5%
More than 25 hours	12.4%

43. Are you a member of a professional student (national) engineering, scientific, or technical society?

Yes	15.5%
No	84.5%

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE December 1994	3. REPORT TYPE AND DATES COVERED Technical Memorandum		
4. TITLE AND SUBTITLE The Technical Communication Practices of Aerospace Engineering and Science Students: Results of the Phase 4 Cross-National Surveys*		5. FUNDING NUMBERS WU 505-90		
6. AUTHOR(S) Thomas E. Pinelli, Laura M. Hecht, Rebecca O. Barclay, and John M. Kennedy				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NASA Langley Research Center Hampton, VA 23681-0001		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, DC 20546-0001		10. SPONSORING/MONITORING AGENCY REPORT NUMBER NASA TM-109123		
11. SUPPLEMENTARY NOTES *Report number 28 under the NASA/DoD Aerospace Knowledge Diffusion Research Project. Thomas E. Pinelli: Langley Research Center, Hampton, VA; Laura M. Hecht: Indiana University, Bloomington, IN; Rebecca O. Barclay: Rensselaer Polytechnic Institute, Troy, NY; John M. Kennedy: Indiana University, Bloomington, IN.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified—Unlimited Subject Category 82 Availability: NASA CASI (301) 621-0390		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) This report describes similarities and differences between undergraduate and graduate aerospace engineering and science students in the context of two general aspects of the educational experience. First, we explore the extent to which students differ regarding the factors that lead to the choice of becoming an aerospace engineer or a scientist, current satisfaction with that choice, and career-related goals and objectives. Second, we look at the technical communication skills, practices, habits, and training of aerospace engineering and science students. The reported data were obtained from a survey of students enrolled in aerospace engineering and science programs at universities in India, Japan, Russia, and the United Kingdom. The surveys were undertaken as part of the <i>NASA/DoD Aerospace Knowledge Diffusion Research Project</i> . Data are reported for the following categories: student demographics; skill importance, skill training, and skill helpfulness; collaborative writing; computer and information technology use and importance, use of electronic networks; use and importance of libraries and library services; use and importance of information sources and products; use of foreign language technical reports; and foreign language (reading and speaking) skills.				
14. SUBJECT TERMS Knowledge diffusion; Aerospace engineering and science students; Computer and information technology use; and Library use and importance		15. NUMBER OF PAGES 86		16. PRICE CODE A05
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT	